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WHEAT STUDIES

OF THE

FOOD RESEARCH INSTITUTE

VOLUME IV

November 1927—September 1928

STANFORD UNIVERSITY
CALIFORNIA

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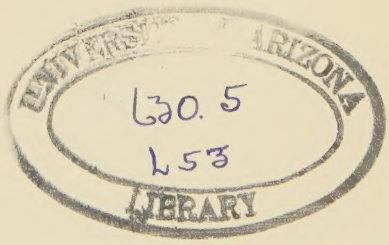

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WHEAT STUDIES, VOL. IV, 1927-28

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ERRORS IN VOLUME IV*

Page 8, Table 2: World ex-Russia, 1926—*for* 3,325, *read* 3,352.

Page 53, Table XVIII: Greece, 1921–26—*for* 966^{e} *read* 966^{m}.

Page 58, Table XXVII: Flour exports, August 1926—*for* 1,442, *read* 1,363.

Page 61, Table XXXII: United States, Seed requirements 1924–25—*for* 88, *read* 84; unmerchantable and lost in cleaning, etc.—*for* 70, *read* 74; footnote, line 15, *for* plus exports, *read* plus re-exports.

Page 101, Table I: *Under* column (1), *for* 536,100 *read* 526,700; *under* column (3), *for* 114,600 *read* 112,600; *under* column (4), *for* 4,850 *read* 4,770; *under* column (7), *for* 13,832 *read* 11,832; *under* column (10), *for* 13,395 *read* 11,395.

Page 123, first column, line 45: *For* because official, *read* because revisions of official.

Page 132, Table VII: Net Imports, Germany, Sept.—*for* 7.22, *read* 6.96.

Page 133, Table IX: Footnote—*for* Tuesday of same week, *read* Tuesday of following week.

Page 273, second column, lines 44–45: *Read* the seed coat or bran; the main part of the berry, the endosperm, which yields the ....

* In general, no attempt has been made to revise figures or statements to accord with later information, or to correct minor typographical errors.

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WHEAT STUDIES

OF THE

FOOD RESEARCH INSTITUTE

VOL. IV, NO. 1 NOVEMBER 1927

THE WORLD WHEAT SITUATION, 1926-27

A REVIEW OF THE CROP YEAR

WHEAT acreage and production, and international trade as well, have shown a pronounced upward trend since the close of the war. In 1926–27 world acreage and international trade attained record heights, and the world crop approached the record yield of 1915–16; yet in most respects the year was fairly normal. No major producers harvested bumper crops or suffered crop failure. The crops were well distributed, though somewhat better in export countries than in import areas. The international position was moderately easy, but exportable surpluses did not seriously depress the market; and prices, though in most countries lower than in the two preceding years, were generally regarded as remunerative to growers.

The major disturbing factor of the year was a radical advance in ocean freight rates in the autumn of 1926, followed by a decline after the end of the British coal strike in mid-November. High freight rates caused a notable widening of the spread between export and import prices, to the disadvantage of importers, and a consequent restriction of overseas trade in the early months of the crop year. As rates receded to normal levels, the volume of international trade increased, and remained on a high level for several months.

World wheat stocks, which had been generally low at the beginning of the crop year, were larger than usual at its close. The willingness to build up stocks, in both exporting and importing countries, helped to sustain prices, and the substantial carryover must be reckoned with in 1927–28.

STANFORD UNIVERSITY, CALIFORNIA

November 1927

WHEAT STUDIES

OF THE

FOOD RESEARCH INSTITUTE

The central feature of the series is a periodic analysis of the world wheat situation, with special reference to the outlook for supplies, requirements, trade, and prices. Each volume includes a comprehensive review of the preceding crop year, and three surveys of current developments at intervals of about four months. These issues contain a careful selection of relevant statistical material, presented in detail in appendix tables for reference purposes, and in summary form in text tables and charts.

Each volume also includes six special studies bearing on the interpretation of the wheat situation and outlook or upon important problems of national policy. Subjects of issues already published are listed inside the back cover.

The series is designed to serve the needs of all serious students of the wheat market, in business, government, and academic circles, by summarizing and interpreting basic facts and presenting current developments in due perspective. The special studies are written not merely for students of the wheat market, but as well for various groups of readers who are especially concerned with the fields discussed.

Volumes I–III are now available, bound in red buckram, at $10.00 each. The ten issues of Volume IV will be published monthly from November 1927 to September 1928, except in April 1928. Ordinarily each issue will reach subscribers in North America early in the month designated. The subscription price for the volume, including a temporary binder, is $10.00. Individual issues may also be purchased separately. Orders, subscriptions, and other communications should be addressed to Food Research Institute, Stanford University, Calif.

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STANFORD UNIVERSITY, CALIFORNIA

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The Food Research Institute was established at Stanford University in 1921 jointly by the Carnegie Corporation of New York and the Trustees of Leland Stanford Junior University, for research in the production, distribution, and consumption of food.

THE WORLD WHEAT SITUATION, 1926-27

A REVIEW OF THE CROP YEAR

This review is designed to present a balanced, comprehensive statement, in due perspective, of a year's developments in the world wheat situation, in the light of fuller information than is available in the course of the year. The series of annual reviews, of which this is the fourth, not merely furnishes a continuing historical record, but makes for an increasingly reliable understanding of the permanent factors in the wheat market and contributes an essential background and basis for analyses, judgments, and forecasts regarding current and future developments.

I. SUMMARY

Large wheat crops; a record volume of international trade; a moderately easy international position; comparatively stable prices on a level neither conspicuously high nor impressively low; and a considerable increase in outward carryovers: these were the outstanding characteristics of the crop year 1926–27. On the whole, it was less eventful than most of the preceding post-war years. But a disturbing factor of major importance appeared in a pronounced advance in ocean freight rates in the early autumn, followed by a sharp decline; this factor materially affected the course of international trade and the course of prices in importing countries. Abrupt changes in new-crop prospects in the spring occasioned another advance and decline in prices.

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World wheat acreage reached a new peak in 1926, and the crop, outside of China, was over 4,200 million bushels—a figure never exceeded except in 1915. These high figures, however, largely reflect the normal upward trend of wheat production rather than exceptional conditions during the year. Yields per acre, in general, were not exceptionally good or poor, though the winter-wheat yield in the United States was unusually high. No major wheat producer harvested a bumper crop, and none suffered severe crop failure. On the whole, crops in exporting countries more than fulfilled their early promise, while crops in importing countries fell somewhat below theirs; but there were no striking reversals of favorable prospects such as occurred in Argentina in 1925–26, and the notable improvement in North American crops took place early in the year. Supplies of wheat were more normally distributed between exporting and importing countries than in either of the two preceding years.

Taking the year as a whole, the international position was moderately easy, with ample supplies in export countries to meet importers' demands. The position was distinctly less easy than in 1923–24, but distinctly less tight than in 1924–25 or 1925–26. There were no major disappointments of expectations of exportable supplies. Even Russia and the Danubian countries, whose exports are nowadays highly uncertain, exported much as observers anticipated. The United States exported more than seemed likely on the basis of the final crop estimate, which is probably too low. Argentine and Australian exports exceeded conservative early forecasts, and Canada's might have done so had not the Pool apparently restrained its sales. European purchases of import wheat considerably exceeded early estimates; in particular Germany, Italy, and Poland, and perhaps France as well, took more than most observers had expected. With large shipments to ex-European countries, the volume of international trade, as indicated by net exports of nearly 850 million bushels, was the largest in history. It is noteworthy that

this record was made with wheat prices on a level distinctly higher than in 1923–24, when the previous record was established; but the figure is less striking if one considers the normal upward trend in wheat production, consumption, and trade.

The abnormal movement in ocean freight rates was a powerful disturbing influence. A sharp advance, first notable in mid-September, culminated late in November, and was followed by an almost equally sharp recession to fairly normal levels. The rise was fundamentally due to abnormal demands for shipping to transport coal from the United States to Great Britain in order to ease the shortage caused by the prolongation of the British coal strike inaugurated in May 1926. Rising rates on wheat were reflected in widening spreads between import and export prices, and chiefly in higher import prices. Importers, bearing the incidence of the higher shipping charges, therefore curtailed their purchases and drew more heavily on export supplies near at hand. Thus the autumnal movement of wheat from overseas was greatly restricted, and many observers were led to underestimate importers' requirements for the year as a whole. When, with the ending of the coal strike in November, freight rates tended downward and prices of import wheats declined, overseas shipments of wheat not only became exceptionally large but remained large for an unusually long period as European purchasers made up arrears.

International wheat prices, which had ruled high in 1924–25 and only moderately lower in 1925–26, declined somewhat further in 1926–27, but by no means to the low level of 1923–24. The general level for the year was sustained by the willingness of importing countries to purchase heavily and the willingness of export countries to build up large stocks. The conspicuous humps in the curve of representative Liverpool prices were caused by ocean freight developments in the autumn and by delayed seeding, adversely affecting new-crop prospects for the time, in the North American spring-wheat belt in May. As usual, however, price relations among different countries and within individual countries showed many peculiarities. In Italy, Germany, and France, millers paid higher gold prices for wheat in 1926–27 than even in 1924–25 because prices of native wheats were enhanced by increased tariff protection and the marketing policies of farmers. Canadian wheat of high quality, in limited supply because of rains at harvest, was much needed in Europe for admixture with mediocre native wheats, and hence commanded a considerable premium on international markets, especially in the second half of the year. Cash prices in the United States were much lower than in 1925–26, when the country was on a domestic basis. Durum wheat was in short supply and commanded a high premium; but hard red spring wheat, also short in supply, enjoyed a smaller premium than would have prevailed if hard red winter wheat had not proved readily substitutable.

World stocks of wheat, which were generally low at the beginning of the year, were distinctly high in many countries at the end. The Canadian carryover out was probably the largest in history. City mills in the United States built up large stocks of high quality winter wheat. Stocks of import wheat in Europe were replenished by heavy arrivals toward the close of the year. Much of the huge Russian crop was apparently employed for stock-building. In Roumania, Italy, and France, farmers held large quantities of wheat as the crop year closed.

Scanty information on changes in stocks precludes detailed analysis of wheat consumption, especially in European countries. In exporting countries consumption of wheat for human food showed few peculiarities, though a high yield of flour per bushel of wheat in the United States made the quantity of wheat milled for domestic consumption no larger than in 1925–26, while in Canada and Argentina comparatively low yields of flour made for exceptional increases. In Germany, Italy, and Poland, where wheat bread is apparently growing in popularity and economic recovery favors its use, wheat consumption was high. Official measures requiring the milling of dark flour and considerable admixture of other cereals with wheat were in force in Belgium, France, and Italy; but these measures apparently had no great effect in reducing wheat imports or wheat consumption.

Millers in the United States, though suf-

fering from chronic overcapacity, were favored by high yields of flour, low premiums for protein content, large supplies of good wheat, and high prices for millfeed, and enjoyed a relatively prosperous year. Canadian millers encountered difficulties largely on account of the Pool's practice of selling wheat more cheaply abroad than at home. British millers faced keen competition from overseas flour-exporting countries. Continental flour-exporting countries faced the same difficulty, and, in addition, flour sales to neighboring importing countries were seriously hampered by tariff barriers erected to encourage milling in several importing countries, notably Czecho-Slovakia, Germany, and Austria. In general tariff policies have apparently tended to restrict volume of international trade in flour in recent years.

II. THE SUPPLY POSITION

Initial Carryovers

The world's supply position for any given crop year depends not only upon the size, quality, and distribution of crops of wheat and wheat substitutes, but also upon the size and distribution of initial carryovers of wheat and wheat flour. Unfortunately statistics of world wheat stocks are particularly deficient. Nevertheless it is clear that the world carryover is always of substantial dimensions. Dependable data indicate that the sum of end-year (August 1) stocks in the four great exporting countries and afloat for Europe has approached or exceeded 300 million bushels in each of the past six years. The total world carryover, ex-Russia and China, perhaps exceeds 450 million bushels even in years when it is relatively small.

Moreover, variations in the size of the carryover may be large in absolute amount —certainly, on occasion, more than 50 million bushels from one year to the next. Such a quantity of wheat is sufficient to affect the world supply position materially and to exert a marked influence on prices; it is, for example, an amount about as large as the reduction in expectations of the Argentine crop which exerted so great an influence on the supply position and prices in 1925–26.[1] The point requires emphasis because changes in stocks from year to year are likely to escape attention since the data are so incompletely recorded.

The world's initial carryover into the crop year 1926–27 may be described as distinctly low, especially by comparison with the large carryovers into 1924–25 and 1927–28. It was considerably smaller than in 1922–23 and 1923–24, but probably somewhat larger than in 1925–26, chiefly because of larger stocks in Russia and the Danubian countries. But countries which had large carryovers into 1926–27—Spain, Poland, Russia, Bulgaria, Hungary, Roumania, and Argentina—were either of small importance to international trade and prices, or held wheat of unusually poor quality. Stocks were distinctly low in the United States and Australia and moderate in Canada, and low also (so far as domestic wheats are concerned) in such major importing countries as England, France, Germany, and Italy. Distinct tightness in the international supply position might have been expected to prevail in the early weeks of the crop year 1926–27 with stocks thus distributed and the European crop late in maturing. But the facts that stocks of import wheat were of fair size in Germany and Italy, that world crop prospects were good, and that the United States winter-wheat crop became available in large volume at an earlier date than usual, served to prevent any appreciable tightness from developing. The subsequent harvesting of large crops removed all fears that import requirements could be satisfied only with difficulty and at relatively high prices.

North American Wheat Crops of 1926

The North American wheat crop of 1926 was unquestionably one of the three largest since the armistice. As in 1922 and 1923, between 1,250 and 1,300 million bushels of wheat were produced in the United States and Canada combined; and the probability that American and Canadian crops of 1926 were underestimated[2] leads to the inference that the North American crop may have

[1] See Wheat Studies, III, 112 f.
[2] See below, pp. 19, 41.

been the largest in post-war years. According to official estimates, it exceeded the crop of 1925 by 155 million bushels. So considerable an increase contributed largely toward the fairly easy international supply position in 1926–27, and permitted a large increase in North American stocks at the end of the crop year. Good but not bumper crops were harvested in both countries—as was not the case in either 1922 or 1923. In 1922 the United States crop was the largest of any between 1920 and 1926, while the Canadian, though large, was not notably so; and in 1923 a bumper crop of 474 million bushels in Canada accompanied an average crop in the United States.

The striking features of the United States crop were the huge quantity and excellent quality of the winter-wheat crop, and the small volume of spring-wheat production. The high quality of hard red winter wheat permitted more than the usual degree of substitution for hard red spring; and notably large quantities of winter wheat moved northward to Minneapolis, thereby largely preventing the emergence of such a premium on hard red spring as might have been expected to arise in view of the short crop. An exceptionally heavy export movement occurred from ports on the Gulf of Mexico as a result of the heavy crops in Oklahoma and Texas. In these and adjacent states the harvest was hastened by extensive use of the harvester-thresher "combine," and early heavy marketing by farmers relieved an early-season shortage of good milling wheat in Europe. Total exports from the United States were large in 1926–27 as a result of the heavy production of winter wheat. In sharp contrast with the situation in 1925–26, domestic prices in general conformed to international prices.

The crop of winter wheat, officially estimated at 627 million bushels, has been exceeded only by the crops of 1914, 1915, and 1919. Favorable weather conditions rather than exceptionally large harvested acreage were responsible for its size. In each of the years 1915 and 1918–23 the harvested acreage of winter wheat was larger than that of 1926, 36.9 million acres; but the 1926 yield per acre, 17 bushels, has been equaled or exceeded only by the record yield of 19 bushels in 1914. Acreage abandoned, estimated at 5.7 per cent of the planted area, was well below the average of 13.0 per cent for the years 1922–26; but the winter cannot be regarded as extraordinarily favorable (except in Texas and Oklahoma) in view of much lower abandonment figures in 1913–15, 1919, and 1921. Apparently the size of the 1926 winter-wheat crop was determined in larger measure than usual by exceptional weather conditions during the period of ripening and harvesting. As of May 1, the official forecast of production was 549 million bushels; as of August 1, the crop was estimated at 626 million bushels. An increase of as much as 77 million bushels in official estimates between May 1 and August 1 had not been recorded in fifteen years.[1] The magnitude of the crop was not recognized until July, when actual threshing returns served to increase the official estimate of August 1 over that of July 1 by nearly 60 million bushels—an increase in which private statisticians concurred.[2]

The quality of the winter-wheat crop was better by far than any since 1921. Over 83 per cent of the crop graded No. 1 and No. 2, whereas the crops of 1924 and 1925, though of distinctly superior quality, contained only 73 per cent of wheat of these grades. In 1926, 49.6 per cent of the crop graded No. 1, in sharp contrast with the next highest reported figure of 30.3 per cent in 1924.[3] So far as can be ascertained only hard red winter was of notably high quality. Much of the soft red winter wheat was damaged by wet weather during the threshing season; and the quality of Pacific white wheat was about average. The exceptional quality of hard red winter explains the general excellence of the total winter-wheat crop, since this class bulked large in the total.[4]

The spring-wheat crop, officially estimated at 205 million bushels, was the small-

[1] The official May forecast of winter-wheat production is more often above than below the August estimate. In five of the past fifteen years, however, it has been lower; but until 1926, never more than 51 million bushels lower. See Appendix Table VII, and *Wheat and Rye Statistics* (U.S. Department of Agriculture, Statistical Bulletin 12), January 1926, p. 17.

[2] See Appendix Table VII.

[3] See Appendix Table VIII. Figures for earlier years are not available.

[4] According to official approximations of production by classes, hard red winter wheat constituted an unusually large fraction of the total United States crop—43 per cent as against 42 per cent in 1924 and 30–36 per cent in other years since 1919. See Appendix Table IX.

est of any since the armistice. Acreage and yield per acre alike were relatively low.[1] Subsoil moisture was scanty, seeding was late, and rainfall was deficient during the growing season. In quality the crop was only fair on account of rains during the latter part of the threshing season, though early-harvested grain was reported high in weight and protein content.[2] Production of both durum and hard red spring wheat was well below the post-war average.[3]

The official estimate of the total United States wheat crop of 1926 thus stands at 833 million bushels.[4] In our judgment, the figure is considerably too low, and the same comment applies to the crop of 1925. Both crops were probably underestimated by 30–60 million bushels; but a more precise figure cannot be suggested because the crops of 1922–24 may have been somewhat overestimated.[5] If the total crop was actually as large as the evidence indicates, it was exceeded only by the crop of 1914, when yield per acre was higher; the crop of 1915, when both acreage and yield per acre were higher; and the crops of 1918 and 1919, when the acreage harvested was much larger. The size of the winter-wheat crop is rendered even more noteworthy, since underestimation presumably occurred with respect to winter wheat rather than spring.[6]

In contrast with the small crop of spring wheat in the United States, Canada produced a crop officially estimated at 410 million bushels, distinctly smaller only than the record crop of 1923, and but little smaller than the excellent crop of 1925.[7] For the second time in ten years the yield per acre of spring wheat in Canada was higher than that in the United States by 7 bushels or more.[8] Yet the Canadian yield per acre of all wheat, 17.8 bushels, was by no means exceptional, for equally good or better yields had been obtained in seven of the preceding sixteen years. But the acreage harvested in 1926, 23 million acres, was exceptionally large, being exceeded only slightly by the record acreage of 1921. Like the United States crop of 1926, the Canadian was apparently underestimated.[9]

A favorable early growing season was followed by heat and drought in July; beneficial rains in August were succeeded by cold and rainy weather throughout most of September and October. As a result of the unfavorable harvesting and threshing weather, much wheat was damaged. As shown by the following data, only 34.6 per cent of the cars of spring wheat inspected in the Western Division from September 1926 to August 1927 graded No. 3 Northern or better—a smaller percentage than resulted even from the abnormally unfavorable seasons of 1924 and 1925:[10]

Year	Per cent	Year	Per cent
1919–20	72.7	1923–24	86.0
1920–21	86.3	1924–25	56.2
1921–22	75.2	1925–26	63.3
1922–23	92.1	1926–27	34.6

Much of the ungraded grain, however, was "tough" but by no means unsatisfactory for milling when dried. In effect there was a noteworthy but unmeasurable shortage of wheat of the highest qualities from the Canadian crop of 1926–27; but usable milling grades were in plentiful supply because the total crop was large. Spring wheat graded as rejected, feed, or condemned—in other words, unsuitable for milling—amounted to 4.4 per cent of all wheat inspected. In 1924–25 and 1925–26, when the percentage grading No. 3 or better was also relatively low, unmillable wheat constituted only 2.0 and 1.2 per cent of the inspections. A figure as high as that of 1926–27 has not been recorded since 1921–22; but in abso-

[1] See Appendix Table X.

[2] Official data on grading are not yet available.

[3] See Appendix Table IX.

[4] An official revision will appear late in December 1927.

[5] See below, p. 19; Appendix Table XXXII; and Wheat Studies, III, 440 f.

[6] Conclusive evidence on this point is lacking; but the differences in successive forecasts (both official and unofficial) for each class of wheat support the inference.

[7] The crop of 1925 was officially estimated at 411.4 million bushels; but an official calculation of disposition indicates an underestimate of 21.8 million bushels and our own calculations yield a higher figure. See *Monthly Bulletin of Agricultural Statistics*, January 1927, XX, 23, and Appendix Table XXXII.

[8] In 1926 the Canadian yield per acre of spring wheat exceeded the American by 7 bushels; in 1923, by 10.4 bushels. Similar differences in relative yields occurred in 1911, 1913, 1915, and 1916.

[9] See Appendix Table XXXII, and below, p. 41.

[10] Compiled from *Reports on the Grain Trade of Canada* and *Canadian Grain Statistics*. The low percentage grading No. 3 or better in 1925–26 was due, as in 1926–27, to distinctly unfavorable harvesting weather; but in 1924–25 frosts during the late growing season increased the percentage of low-grade grain.

lute terms unmillable wheat was by no means considerable.

European Crops

European countries (ex-Russia) in 1926 harvested a wheat crop nearly 200 million bushels smaller than the record post-war crop of 1925. The crop was nevertheless above the post-war average by some 17 million bushels, much larger than the crops of 1920, 1922, and 1924, and but little smaller than the good crops of 1921 and 1923. The five-year pre-war average production was not attained, though it had been surpassed in 1925 for the first time since the armistice. Crops of rye and potatoes, the chief substitutes for wheat, were also distinctly small by comparison with 1925, though about of average size. The outturn of corn, barley, and oats was the largest in post-war years. Data for these crops are summarized in Table 1. During the past five years the European supply situation as a whole has

Table 1.—European (Ex-Russian) Grain and Potato Crops, 1920–26*

(Million bushels)

Year	Wheat	Rye	Potatoes	Corn	Barley	Oats
1920.....	947	532	3,351	520	551	1,478
1921.....	1,216	758	3,078	393	566	1,509
1922.....	1,039	713	4,803	426	602	1,542
1923.....	1,249	824	3,864	475	668	1,814
1924.....	1,051	651	4,216	591	577	1,631
1925.....	1,401	938	4,757	627	694	1,795
1926.....	1,208	746	3,826	663	691	1,914
Average						
1909–13...	1,348	976	4,158[a]	581	701	1,931
1921–25...	1,191	777	4,144	502	621	1,658

* Summarized from most recent official data for individual countries, as reported by the U.S. Department of Agriculture. Excludes a few minor European producers. Pre-war averages are estimates for territory within present boundaries, and include 2-year or 4-year averages for a few countries.

[a] Excludes Portugal.

twice been better, twice worse. It is of interest to observe that European imports of wheat and wheat flour in 1926–27 were nevertheless larger even than those of 1924–25, when supplies were far smaller, or those of 1923–24, when supplies were not much larger but wheat prices were much lower.

The comparatively small European wheat crop of 1926 is accounted for largely by the small crop in France, where the growing season was wet and cold and rust did much damage. The revised official estimate indicated an outturn of only 232 million bushels, the smallest since 1919, and nearly 100 million below the crop of 1925; but the estimate is probably below the true figure.[1] Germany, Italy, and Spain harvested crops smaller than those of 1925 by a total of about 60 million bushels; but in these countries production was above the post-war average. Hungary and Roumania, on the other hand, had the largest crops since the armistice; and total production in the four Danubian countries was within a few million bushels of the record post-war production in 1925. Smaller producers of Europe in general harvested crops of average size.

In certain respects the European wheat crop distinctly disappointed early expectations. The acreage harvested was the largest since the war, in continuation of an upward trend.[2] In view of this trend the outturn compares the less favorably with that of preceding years. Moreover, few European countries harvested crops of good quality. Weight per measured bushel was light in practically all countries, and notably so in Roumania and Germany, chiefly as a result of wet weather during the harvest. On the whole the quality of European wheat was apparently below average. It further became necessary to reduce official estimates of production during the course of the crop year. Subsequent to November 1926, significant upward revisions in official estimates were made only in Hungary and Czecho-Slovakia, while downward revisions of consequence were made in France, Germany, Spain, Jugo-Slavia, and Poland. Net revisions downward since November 1926 have amounted to 39 million bushels; and estimates current in November were substantially lower than those current in August.[3] Threshing returns led also to reductions in the official estimates of rye crops—a total net reduction of 34 million bushels.[4] However, the significance of these reductions in their bearing on the international statistical position was lessened by outturns of wheat in the Southern Hemi-

[1] See below, p. 44.

[2] See Appendix Table I.

[3] See Appendix Table III; cf. Wheat Studies, II, 349, and III, 128.

[4] See Appendix Table IV; cf. Wheat Studies, III, 129.

sphere somewhat larger than had been expected in November.

If Russian production is to be given full weight as a part of European production, the picture is apparently somewhat altered. The official estimate indicated a wheat crop of 810 million bushels, nearly 100 million larger than the crop of 1925, which was in turn perhaps 300 million larger than any other reported crop since the war. The rye crop was also estimated to be the largest in post-war years, exceeding that of 1925 by over 80 million bushels. The bread-grain crops of Europe, Russia included, were thus but little smaller in the aggregate than those of 1925, and much larger than in any other post-war year. But bread-grain production in Russia thus far signifies little for the importing countries of Europe, since large crops in Russia apparently serve to increase domestic consumption and stocks rather than to increase exports. Furthermore, the accuracy and comparability of Russian production statistics are open to question, especially for the years immediately following the war.[1]

Other Northern Hemisphere Crops

The North African wheat crop of 1926, like that of Europe ex-Russia, was considerably smaller than the crop of 1925; and it was slightly below the average for post-war years. In this region also the acreage harvested was the largest since the war.[2] Algeria and Egypt harvested crops of about average size; the Moroccan crop was distinctly small, the Tunisian the largest since the armistice. Production in India, finally estimated at 325 million bushels, was much the same as in 1925, considerably below that of the three good years 1922–24, and scarcely more than sufficient to fill domestic requirements. The Japanese crop of 38.7 million bushels was of average size. Satisfactory information on the Chinese supply situation is not available; but apparently the crop was about of average size.

[1] Compare, for example, the data and explanatory notes given in *Agriculture Yearbook, 1926*, p. 807, and *International Yearbook of Agricultural Statistics, 1926–27*, pp. 117, 568 f.

[2] See Appendix Tables I–III.

[3] See *ibid.*

[4] See Wheat Studies, III, 81 f.

Southern Hemisphere Wheat Crops

In the Southern Hemisphere, as in North America, the wheat crop of 1926 was of record size. The Australian crop, officially estimated at 161 million bushels, was the largest in history except for the 165 million bushel crop of 1924; the Argentine crop of 221 million bushels was exceeded only by that of 248 million bushels in 1923. The total for the two countries exceeded production in 1925 by over 75 million bushels. In both countries the acreage sown was the largest in history. Yield per acre on harvested fields in Australia at 14.5 bushels was distinctly high, though not so exceptional as the acreage. In Argentina, however, the yield per acre was apparently rather low; acreage rather than yield was responsible for the size of the crop.[3]

The Australian wheat crop promised well throughout the growing and harvesting season, with rain and fair weather occurring at appropriate stages of growth. Quality was distinctly good, though weight per measured bushel was lower than in 1925. In Argentina, however, the growing season gave rise to continuous uneasiness—in part, perhaps, because the unexpected reversal of crop prospects in 1925 remained fresh in the memory of traders.[4] Excessive moisture during the early growing season promoted too rapid growth of the stalk and rendered the wheat plant susceptible to adverse weather conditions. Drought and light frosts toward the end of the growing season and rain at harvest caused damage particularly difficult to evaluate at the time. Not until January, despite a harvest two or three weeks early, were observers agreed that a crop of good size and high quality was assured. Argentine wheat of 1926 was high in weight but not in protein content; it was far superior to that of 1925, and permitted an indeterminate amount of mixing of old-crop wheat of poor quality with the new.

Of other countries of the Southern Hemisphere, Chile harvested the smallest crop since 1920, some 3 million bushels smaller than the crop of 1925, and of poor quality. The crops of Uruguay, South Africa, and New Zealand, though not of distinctly exceptional size, were well above both prewar and post-war averages.

World Wheat Crops Summarized

Trends in acreage considered, the crop year 1926–27 was a normal year with respect to the size and distribution of world wheat crops. In the major producing areas there were no bumper crops and no crop failures. A summary view of the world's wheat crops of 1926 in comparison with the crops of recent years and pre-war and post-war averages is given in Table 2. Russia and China excluded, the world wheat crop was one of the three largest since the war, a little larger than the crop of 1925, and distinctly exceeded only by the crop of 1923. If, as we believe, the 1925 and 1926 crops of both Canada and the United States were underestimated, the world crop of 1923 appears less notable. If the Russian crop is included in the comparison, the world crop of 1926, China excluded, was the largest in post-war years. It was little larger than the crop of 1925, but considerably larger than that of 1923, since (though entirely trustworthy data are lacking) there can be little doubt that the Russian crop of 1923 fell more than 200 million bushels below the crop of 1926. So far as can be determined, the world crop of 1926, ex-China, exceeded 4,200 million bushels, an outturn never before attained except in 1915.

But the large size of the 1926 crop was due to exceptional acreage rather than to exceptional yield per acre. The United States Department of Agriculture estimates the wheat acreage of the world, Russia and China excluded, at 232 million acres.[1] So far as this figure represents the facts, it appears that acreage in 1926 exceeded the pre-war 1909–13 average by some 28 million acres and was the largest in post-war years, surpassing that of either 1923 or 1925 by over 4 million acres. With Russia included in the comparison, acreage in 1926 was nearly 15 million acres larger than in 1925.

Table 2.—Wheat Production in Principal Producing Areas, Pre-War and Post-War*

(Million bushels)

Year	United States	Canada	Soviet Russia	Lower Danube[a]	Other Europe	North Africa	India	Japan, Chosen	Northern Hemisphere ex-Russia	Argentina	Australia	Southern Hemisphere	World ex-Russia
1920.....	833	263	...	172	775	71	378	41	2,550	156	146	350	2,900
1921.....	815	301	...	212	1,004	98	250	40	2,727	191	129	376	3,103
1922.....	868	400	...	224	815	72	367	40	2,801	196	109	354	3,155
1923.....	797	474	...	260	989	106	372	35	3,051	248	125	427	3,478
1924.....	864	262	...	204	847	85	361	37	2,673	191	165	407	3,080
1925.....	676	411	713	305	1,096	105	331	40	2,976	191	115	359[b]	3,335[b]
1926.....	833	410	810	298	910	90	325	39	2,917[c]	221	161	435[b]	3,325[b,c]
Average 1909–13...	690	197	759	330	1,018	92	352	32	2,724	147	90	280	3,004
1921–25...	804	370	...	241	950	93	336	38	2,845	203	129	385[b]	3,230[b]

* Summarized from most recent official data for individual countries (see Appendix Table III), as reported by the U.S. Department of Agriculture, supplemented in a few cases by our own rough estimates. Totals exclude China, Turkey in Europe, Brazil, and a number of small producers. All estimates are for territory within post-war boundaries.

[a] Hungary, Bulgaria, Roumania, Jugo-Slavia.

[b] Includes our estimate for Peru.

[c] Includes our estimate for Cyprus.

The average world yield per acre, however, was lower not only than in the period 1909–13, but also than in 1923 and 1925. Among the major producing countries distinctly exceptional yields per acre were obtained only in Australia and in the United States winter-wheat belt;[2] and in these areas yields were not the highest on record.

In distribution between the major producing areas the crop of 1926 differed sharply from that of the preceding year. On the basis of official estimates, the four great exporting countries had crops 232 million bushels larger in 1926 than in 1925,[3] chiefly as a result of much larger crops in the United States and Australia. But the importing countries of Europe had crops nearly 200 million bushels smaller, with the

[1] *Agriculture Yearbook, 1926*, p. 810.

[2] See Appendix Tables II, X.

[3] Allowances for official underestimates of North American crops in 1925 and 1926 would not alter the contrast greatly.

major part of the reduction accounted for by the poor crop in France. It was, however, the distribution in 1925 that was exceptional, rather than the distribution in 1926.

The International Statistical Position

At present there exists no wholly satisfactory method for setting forth, graphically or numerically, the world's quantitative demand for wheat against the world's supplies, for the purpose of explaining or anticipating what may be called the level of international wheat prices in different crop years. As we have had occasion to point out in our previous studies, changes in the distribution of world crops are often as significant as changes in the size of the total, since different distributions result in different relationships between quantities of wheat available in exporting areas and desired in importing areas. Broomhall's estimates of export surpluses and import purchases may be taken as a broadly representative view of the international position, at least so far as noteworthy differences between years are concerned. In years when the margin between export surpluses and import purchases is relatively wide, there can be no question that the international position is easy—that is, traders are agreed that supplies ample to meet importers' demands are available, and that lower prices must prevail than when the margin is distinctly narrow. Yet the size of the margin necessarily changes from month to month in the course of any year, principally because the world's wheat matures and is harvested in successive increments, and preliminary forecasts of production in various countries are followed by further estimates and revisions, the latter often appearing more than six months after the crop is harvested. At any given time students differ in the details of interpreting the statistical position for the year in question, though their general views on the position in one year as compared with another may be in accord.

Broomhall's successive estimates of surpluses and probable purchases for the past five years are summarized in Chart 1 (p. 10). The international position was easiest in 1923–24, tightest in 1924–25. Relative tightness prevailed in 1925–26, relative ease in 1922–23 and in the year under review, 1926–27. The distribution of wheat crops between European importing areas and the major exporting countries accounts largely for these differences.[1] Pertinent figures, in million bushels, in part estimated to allow for official underestimates of North American crops in 1925 and 1926, are as follows. The figures for Europe include all countries but Spain and the exporters of the Danube basin. The major exporters are Canada, the United States, Argentina, and Australia.

	1922	1923	1924	1925	1926
European importers	690	830	720	930	760
Major exporters	1,570	1,640	1,480	1,450	1,670

As compared with 1923–24, the statistical position in 1926–27 was less easy because Europe had smaller crops, not only of wheat but of its chief substitute, rye. As compared with 1925–26, the position in 1926–27 was easier because larger crops in major exporting countries more than compensated for smaller crops in Europe.

During the course of the crop year Broomhall made revisions of marked significance.[2] Supplies available for export were increased by successive revisions from 768 million bushels on August 10 to a maximum of 908 million bushels on March 22, chiefly in accord with improving crop prospects in the Southern Hemisphere. None of these revisions appeared unreasonable at the time. But his estimate of importers' purchases remained at the same figure, 704 million bushels, from August 10 until December 14; and not until March 22 did he reach a figure of 760 million. It appears clear that by December the available information on production, prices, and the progress of the British coal strike justified earlier and more extensive upward revisions than Broomhall recorded.[3] Even if such revisions had been undertaken, however, the international position would have remained fairly easy. No such fundamen-

[1] The year 1922–23 appears exceptional, since, in spite of a very small crop in Europe and only a moderate crop in the exporting countries, the statistical position was easy. Comparatively low purchasing power and a smaller population in Europe account for the apparent anomaly.

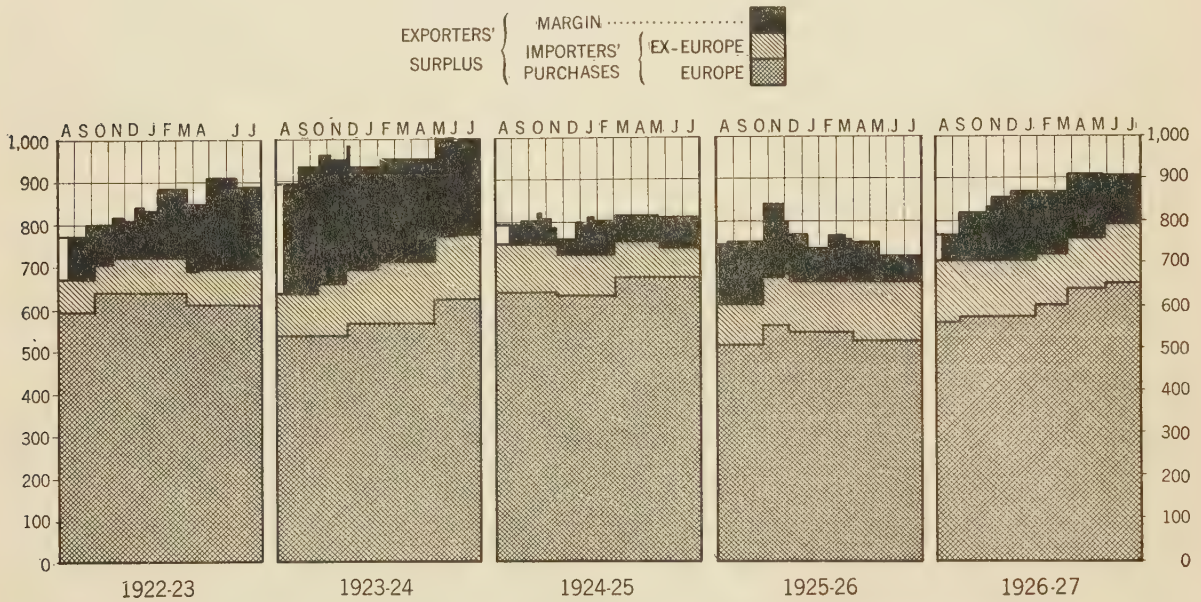
[2] See Appendix Table XII.

[3] See Wheat Studies, III, 425 f.

tal alterations in the statistical position occurred in 1926–27 as had occurred in 1925–26. In that year an easy position was anticipated in early months, only to be reversed by the Argentine crop disaster and the non-appearance of expected heavy exports from Russia and the Danube basin; and the tight position in the latter part of the year was exaggerated by failure to consider evidence suggesting a large underestimate of North American crops.[1] Except for 1923–24, the statistical position remained more consistently easy in 1926–27 than in any of the past five years. Such tightness as existed was apparent only in the first few weeks; but this was relieved by early marketing of United States winter wheat, and dispelled by the large crop in Canada.

CHART 1.—BROOMHALL'S SUCCESSIVE FORECASTS OF EXPORTERS' SURPLUSES AND IMPORTERS' PURCHASES, 1922–23 TO 1926–27*

(Million bushels)



* Data from *Corn Trade News*. See Appendix Table XII for 1926–27 figures.

III. INTERNATIONAL TRADE IN WHEAT AND FLOUR

THE VOLUME OF TRADE

The movement of wheat and flour in international trade in 1926–27 attained the largest volume in history.[2] Chart 2, which summarizes Broomhall's data on international shipments, shows the growth of trade since 1900. An upward trend (as yet unmeasurable) for post-war years is evident, as would be expected in view of increasing population. Post-war improvement in European purchasing power and a growing preference for wheat bread have increased the normal rate of growth of trade. But the record volume of trade in 1926–27 can be explained only in part by reference to these obscure influences. More detailed comparisons for recent years are significant. Broomhall's figures for shipments and a summation of official statistics of net ex-

[1] See WHEAT STUDIES, III, 79.

[2] The volume of trade may be measured by different methods which yield slightly different results—by reference either to total gross exports, total net exports, shipments data collected by the *Corn Trade News* or the *London Grain, Seed and Oil Reporter*, or to total gross or total net imports. Since import statistics are notably deficient, especially for ex-European importing countries, and since they seldom appear promptly, students are forced to rely chiefly upon export data. Yet such data, on account of the fact that much wheat is shipped to "orders," provide but scanty information on the destination of exports; and import data, though not strictly synchronous with export data, must be employed. We employ net exports as the best indicator of the volume of trade, but Broomhall's shipments, while understating net exports to different degrees in different years, are satisfactory for many purposes, and are essential for providing a description of the course of trade from week to week.

ports, in million bushels for the past five years, are given below.

Year August–July	Net exports[a]	Total shipments[b]	Shipments to Europe	Shipments to ex-Europe
1922–23	711	676	586	90
1923–24	826	775	626	149
1924–25	767	715	640	75
1925–26	693	668	533	135
1926–27	849	815	683	132

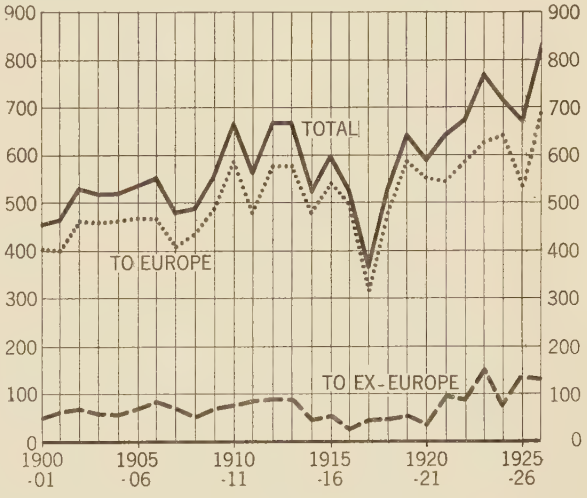
[a] See Appendix Table XVII. Partially estimated, especially with reference to Russian exports.
[b] See Appendix Table XVI.

The volume of trade was larger in 1926–27 than in the preceding year by about 150 million bushels. As between these two years the distribution of world crops and the level of prices were the significant points of difference, since more obscure influences such as population growth, increased purchasing power, and growing preference for wheat bread show their effects over longer periods of time. Purchasing power of consumers in Europe was apparently no greater in the major importing countries in 1926–27 than in 1925–26—in Great Britain because of the coal strike, in Italy and France because of the recession of business following provisional stabilization of the currency.[1] But in 1926 European importing countries harvested wheat crops about 170 million bushels smaller than in 1925; the four major exporting countries had crops over 200 million bushels larger;[2] and international wheat prices were lower.

The record volume of trade in 1926–27 nevertheless proved surprising to most students: heavy trade was early anticipated, but many did not expect a record movement. For this miscalculation the difficulty of forming a judgment on the basis of records of past years was largely responsible. The volume of trade had been unusually heavy in 1923–24 and 1924–25: in 1923–24 because exceptionally low prices resulting from large crops in both importing and exporting areas had encouraged heavy consumption, especially in the Orient; in 1924–25 because distinctly small European crops had necessitated heavy importation despite high prices.[3] During the early months of the crop year 1926–27 many did not anticipate a volume of trade larger than that of 1923–24, and perhaps 1924–25; for neither prices so low as in 1923–24 nor crop shortages in Europe so pronounced as in 1924–25 seemed probable. The fact that shipments to Europe exceeded those of 1923–24 by over 55 million bushels and those of 1924–25 by over 40 million proved a distinct surprise to most observers.

Chart 2.—International Shipments of Wheat and Flour, 1900–01 to 1926–27*

(Million bushels)



* Broomhall's data, from *Corn Trade Year Book* and *Corn Trade News*.

Several factors may be cited in explanation. Forecasts and estimates of European wheat and rye crops suffered reduction in the course of the year, revealing a greater need for wheat imports than had been anticipated earlier. The effect of the situation in ocean freight rates in reducing the volume of trade in early months of the year led observers to underestimate the probable volume for the year as a whole. International wheat prices declined slowly from November to April, and were lower than in the two preceding crop years. The influence of the obscure upward trend in the demand for wheat, resting on population growth and increasing preference for wheat bread, was doubtless felt in some degree. Stabilization of currency, tending to remove an influence toward restriction of

[1] In Germany, however, the index of real wages was on the whole higher in 1926–27 than in the preceding years.
[2] See above, p. 9.
[3] See Table 2, p. 8, and Chart 6, p. 24.

imports, was effected in Belgium, France, and Italy.[1] These factors, however, were for the most part such as to influence importation in general. As events proved, the notable miscalculations of the year were made only with respect to Germany, France, Italy, and Poland, the European countries which purchased appreciably more wheat and flour than observers anticipated.

Imports and Their Distribution

Net imports of the leading European importing countries are summarized, with comparisons, in Table 3.[2] The British Isles imported over 25 million bushels more than in 1925–26; but the figure for 1926–27 is unusual only by contrast with that of the preceding year, when exceptionally heavy drafts were made upon stocks and consumption was reduced. Most observers early in the year anticipated a figure but little smaller than was reported; and such was the case with respect to most other countries.

German net imports, however, were 91.8 million bushels, undoubtedly the largest in any year since the war. As late as December most observers expected imports of less than 80 million bushels. Changes in crop forecasts were largely responsible for the underestimates. The rye crop was officially estimated at 295 million bushels in September, at 271 million in October, at 252 million in January; and the estimate of the wheat crop fell from 112 million in October to 95 million in January. These reductions altered current views on the domestic supply situation substantially. Furthermore, quality turned out to be poorer than had been expected. In 1924–25, in spite of substantially smaller wheat and rye crops in 1924–25, Germany's imports were but 80.9 million bushels. As between these two years the larger importation of 1926–27 is explained not by smaller crops, but by increased purchasing power, lower wheat prices, and growing population and preference for wheat bread. In both years end-year stocks of import wheat were large, though for different reasons.[3]

Italian net imports, 86.6 million bushels, were not of record size for post-war years, but were distinctly surprising in the view of the size of the domestic crop, the revision of crop estimates upward, the high tariff, and regulations respecting the milling and admixture of flour.[4] In 1924 the crop was 50

Table 3.—Net Imports of Wheat and Flour by Principal European Importing Countries, August–July, 1922–27*

(Million bushels)

Importing area	1922–23	1923–24	1924–25	1925–26	1926–27
British Isles[a]	210.3	239.7	227.9	209.9	237.0
Italy	115.7	69.9	88.7	67.7	86.6
Germany	37.5	30.7	80.9	57.4	91.8
France	45.6	53.3	58.5	10.3	62.0
Belgium	39.5	40.0	39.0	39.2	39.5
Netherlands	23.9	26.7	26.8	27.2	28.4
Scandinavia[b]	22.0	27.7	22.7	18.8	19.6
Switzerland	16.6	17.1	13.9	15.6	16.3
Austria	13.4	18.1	16.0[c]	14.7[d]	16.9[c]
Czecho-Slovakia	10.2	21.2	21.5	21.7	20.1
Poland	2.5	2.6	17.1	....[e]	8.1
Baltic States[f]	7.4[c]	7.9	7.3	7.8	7.8
Greece	17.5	18.8	20.8	20.0[g]	20.0[g]
Total	562.1[c]	573.7	641.1[c]	510.3[c]	654.1[c]

* See Appendix Table XVII for sources and further details.

[a] Includes Irish Free State.
[b] Norway, Sweden, Denmark.
[c] Partially estimated.
[d] July–June.
[e] Net export of 4.6 million bushels.
[f] Finland, Latvia, Esthonia.
[g] Estimated.

[1] In France and Italy, however, the final steps in stabilization have not yet been taken.

[2] It will be observed that total net imports of the European countries listed in Table 3 were only 13 million bushels larger in 1926–27 than in 1924–25; and in 1924–25 Russia imported some 10–15 million bushels. On the basis of these figures (though all important countries are included) it is improper to conclude that European net imports were appreciably larger in 1926–27 than in 1924–25. On the other hand, Broomhall's shipments to Europe were 43 million bushels larger in 1926–27 than in 1924–25; and one may conclude that Europe purchased appreciably more wheat and flour in the former year. This discrepancy results from the fact that imports are recorded later than shipments. Hence the import figure for 1924–25 was swelled by heavy shipments in the closing months of 1923–24, while the import figure for 1926–27 is smaller than otherwise it would appear on account of heavy shipments to Europe toward the close of the year. Thus, unless exceptionally heavy shipments are made toward the close of 1927–28, the import figure for 1927–28 will be higher in relation to the figure for 1926–27 than will be the case for export figures.

[3] Imports were heavy toward the end of 1924–25 in anticipation of increased tariffs; in the latter months of 1926, largely as a result of heavy purchases in anticipation of a late harvest of domestic wheat in European countries.

[4] See below, p. 39.

million bushels smaller than in 1926; yet imports were only 2 million bushels larger. In December most observers anticipated imports some 10 or 15 million bushels smaller than were finally reported. Lower prices in 1926–27 than in 1924–25 seem inadequate to account for the difference. Increased purchasing power, appreciation of the exchange, and increasing consumption of wheat bread partially explain the heavy imports. A factor of major significance, however, was the marketing of domestic wheat by farmers. It is reported that, since farmers expected rising prices, domestic marketings of wheat were restrained until the spring of 1927.[1] Grain dealers accordingly imported more heavily than would otherwise have been necessary, or than could have been foreseen.

The situation in France is not clear. The reported total of net imports was 62 million bushels, an amount on the whole larger than many observers expected. Apparently, however, this figure understates the facts; for importers, in view of uncertainty regarding proposed tariff changes, are said to have declared an indeterminate proportion of their imports in the latter months of the year under temporary admission clauses of the tariff. An unknown quantity of wheat and flour thus remains unaccounted for in the customs returns.[2] It is clear, however, that French imports exceeded expectations,[3] despite a high tariff fully in effect after January 1, 1927,[4] and public measures to restrict consumption effective throughout the year.[5] Partial explanation lies in the facts that appreciating and stabilized currency encouraged importation; that the wheat crop, unofficially announced by the French Minister of Agriculture in August as one of 280 million bushels, subsequently turned out to be smaller, and was officially estimated at 257 million in October and 232 million in June following; and that, despite the small crop, farmers held ample reserves of domestic wheat at the close of the crop year.

Poland's imports of 8.1 million bushels were small in absolute amount; but the country had provided a small net export in 1925–26, and many observers anticipated a continuation of exports in 1926–27. Small exports occurred, in fact, until December. Thereafter imports became increasingly heavy, especially in April–June as domestic supplies were exhausted.[6] As in France and Germany, early estimates of wheat and rye production proved too high.

The imports of ex-European countries constitute a far from negligible item in the annual volume of trade, about 10–20 per cent of the total. Unfortunately, however, figures are available only in the form of Broomhall's shipments.[7] Shipments to ex-Europe, reported as 132 million bushels, were fairly large, though smaller than in 1923–24, when low prices induced heavy purchases in the Orient, or in 1925–26, when prices were high but Chinese crops were poor and Japan imported heavily in anticipation of increased tariff duties.[8] Developments in these countries contributed but slightly to the surprisingly large total volume of international trade. Fairly high prices, the disturbances in China, and the financial difficulties of certain Japanese millers served to restrain imports to the Orient to a greater extent than increasing wheat consumption in most areas served to increase the total of ex-European takings. Students of the situation apparently anticipated ex-European imports more accurately than European.

[1] Information supplied by our correspondent, Mme Agresti.

[2] Information supplied by our correspondent, M. Augé-Laribé.

[3] The influential *London Grain, Seed and Oil Reporter*, however, expected heavier imports than actually occurred. Our own December estimate of 65 million bushels was also comparatively high. See WHEAT STUDIES, III, 166.

[4] See p. 29, note 2.

[5] Admixture of 10 per cent of flour from other cereals with wheat flour was made compulsory; and millers were obliged to obtain an extraction one per cent above the specific weight of wheat per quintal (after March 22, 1927, 1 per cent below), which implies a rate of extraction of well over 70 per cent.

[6] See Appendix Table XXI.

[7] No adequate check on the accuracy of Broomhall's data is as yet available. Fairly comprehensive statistics on exports from the major exporting countries by destination suggest that Broomhall's figures have understated the movement to ex-European countries in 1922–25, but not in 1925–27. Nevertheless, Broomhall's data probably reflect year-to-year variations with sufficient accuracy for most purposes.

[8] China, Japan, Brazil, the West Indies, and Egypt are in most years the leading importers among ex-European countries; and variations in Japanese and Chinese imports, due chiefly to changes in prices, cause most of the year-to-year variations in total ex-European imports. See Appendix Table XIX.

Sources of Exports

The relative contributions of the several exporting areas to the total volume of wheat and flour exports during 1926–27 showed few striking features. Comparisons are shown in Table 4. North America maintained her characteristic post-war predominance, with 58 per cent of the total. The contributions of most other areas were large or small as crop production dictated.

Table 4.—Net Exports of Wheat and Flour from Principal Exporting Countries, August–July, 1922–27*

(Million bushels)

Exporting area	1922–23	1923–24	1924–25	1925–26	1926–27
United States	200	127	256	103	199
Canada	279	346	192	324	293
Argentina	139	172	123	94	143
Australia	50	86	124	77	103
India	29	20	38	8	14
Danube basin[a]	12	34	25	46	46[b]
Russia	...[c]	23	...[d]	27	49
Other countries[e]	2	18	9	14	2
Total	711	826	767	693	849

* See Appendix Table XVII for sources and further details.

[a] Bulgaria, Hungary, Jugo-Slavia, and Roumania.
[b] Partially estimated.
[c] No data available; probably a small net export.
[d] Net import.
[e] Includes Morocco, Algeria, Tunis, Chile, Spain, and Poland, for the years in which these countries were net exporters.

In 1926–27 there were no such noteworthy disappointments as occurred with respect to Russian and Argentine exports in 1925–26. On the contrary, all countries, Canada excepted, supplied somewhat larger quantities of wheat than most observers anticipated. That expectations were generally exceeded is chiefly to be explained by the method in which observers ordinarily forecast exports. Annual figures for exports and imports are frequently assumed to balance except for changes in stocks afloat;[1] the probable total volume of trade is based principally upon calculations of import requirements; probable exports are made to balance probable imports. The forecasting of exports from various countries is not an independent procedure based wholly upon domestic disappearance in those countries.[2] As we have indicated above,[3] miscalculations respecting the total volume of trade in 1926–27 were due principally to underestimates of the takings of France, Germany, Italy, and Poland. For the most part exports would have been forecast at higher figures if imports to these four European countries had been more correctly foreseen.

Nevertheless, certain miscalculations of exports were inevitable on account of crop developments in exporting areas. In the early months of the crop year official estimates of production, taken in connection with the records of disposition for past years, and the probability of an increase in carryover out, supported the view that net exports from the United States would not exceed 170 million bushels. The actual figures of 199 million (or 206 million for a July–June year) imply, in our opinion, an underestimate of the 1926 crop,[4] evidence of which could not become convincing until toward the close of the year. The large exports from the Southern Hemisphere of course could not be foreseen early in the crop year, since production in Argentina and Australia was then uncertain. Outturns in these countries proved slightly larger than seemed probable;[5] and in Argentina the mixing of old-crop wheat of poor quality with good new wheat added more largely to available exportable supplies than many had thought possible. Hence exports exceeded anticipations. The Indian crop harvested in March–June 1927 proved large enough to provide some 8 million bushels for export in June and July.

Curiously enough, the exports of Russia, though necessarily difficult to estimate in advance because statistics both of crops, ex-

[1] This assumption appears untenable. For the past five years the sum of net exports has annually exceeded the sum of net imports so far as this sum can be calculated in view of the deficiencies of import statistics for ex-European countries; and the continuing appearance of the excess cannot be accounted for by changes in stocks, or otherwise than by simple disappearance of wheat.

[2] This is the fact with respect to the practice of European observers, notably Broomhall, and most American students. Our own calculations of probable net exports have been more largely, yet not entirely, independent of our calculations of probable net imports.

[3] See p. 12.

[4] See Wheat Studies, III, 168, 270, 426, and Appendix Table XXXII.

[5] As late as December official estimates of production indicated a crop of 215 million bushels in Argentina, of 154 million in Australia. Subsequent revisions brought the figures to 221 and 161 million respectively.

ports, and disposition are deficient for past years, proved to coincide closely with the guesses of observers. The experience of 1925–26, when far larger exports were anticipated than actually occurred, made for conservative guesses for 1926–27, despite the acknowledged large size of the Russian crop. That exports from the Danubian countries about equaled expectations was also partly accidental. Not only did the disappointment of expectations in 1925–26 make for conservative estimates of 1926–27 exports, but also less would have been exported, especially in view of the poor quality of Roumanian wheat, had not the high ocean freight rates prevailing during the first few months of the year led European importers to seek supplies in exporting countries whence transportation charges remained relatively low. Roumania had the largest crop of post-war years, 111 million bushels, but exported only about 10 million. Hungary and Jugo-Slavia, with combined crops smaller than in 1925, were the chief beneficiaries of the advance in ocean freight rates, and exported heavily.

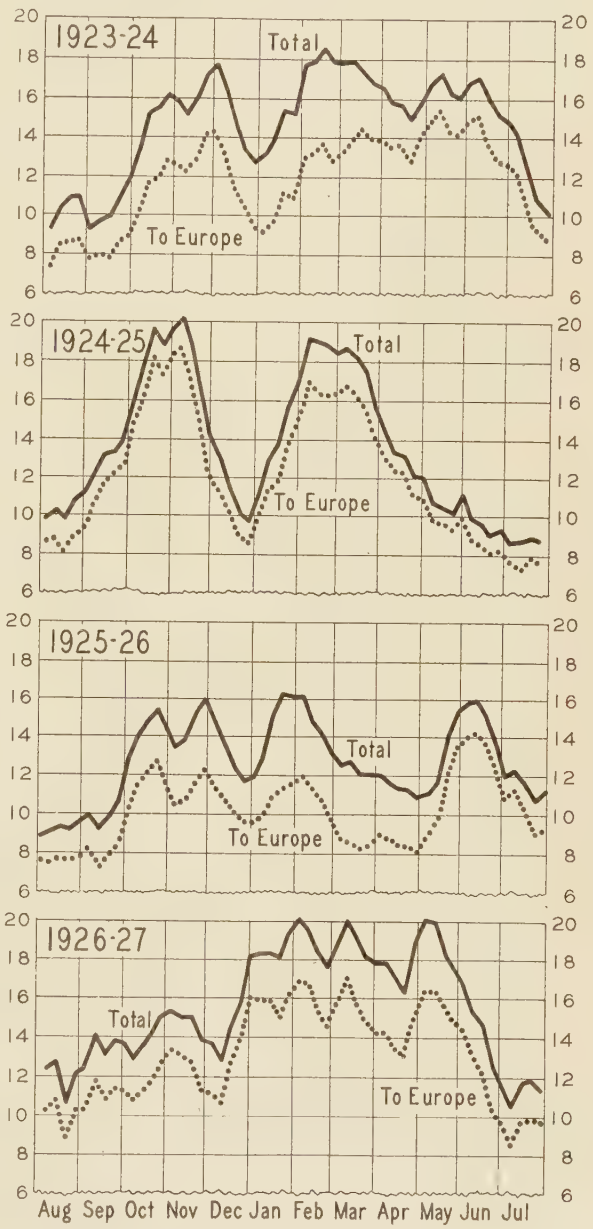
Canadian exports of 293 million bushels were not surprisingly large or small, but they were probably somewhat smaller than would have been the case in the absence of the Canadian Wheat Pool. It is the general belief of traders that the Pool restricted sales during the winter months in anticipation of higher prices in the spring or in the coming crop year. Whether or not this policy was deliberately followed cannot be ascertained. But the Canadian carryover at the end of the year, 51 million bushels, was larger even than the 45 million bushel carryover from the larger crop of 1923,[1] which brought much lower prices; and this fact seems to imply a policy of restricted sales, at least of the poorer grades.[2]

The Course of Exports

The seasonal movement of wheat and flour exports is seldom the same in any two years. Variations in the distribution of crops between the Northern and Southern Hemispheres, in wheat prices, in dates of harvest and rapidity of marketing in both importing and exporting areas, and in the dates of opening and closing of navigation on the Great Lakes, all make for noteworthy differences. Chart 3, which shows Broomhall's weekly shipments data smoothed by a 3-week moving average, illustrates the diversity of the export movement in

Chart 3.—International Shipments of Wheat and Flour, Weekly from August 1923*

(Million bushels; 3-week moving average)



* Broomhall's data, from the *Corn Trade News*.

[1] See Appendix Table XXIII.

[2] See below, pp. 19 f.

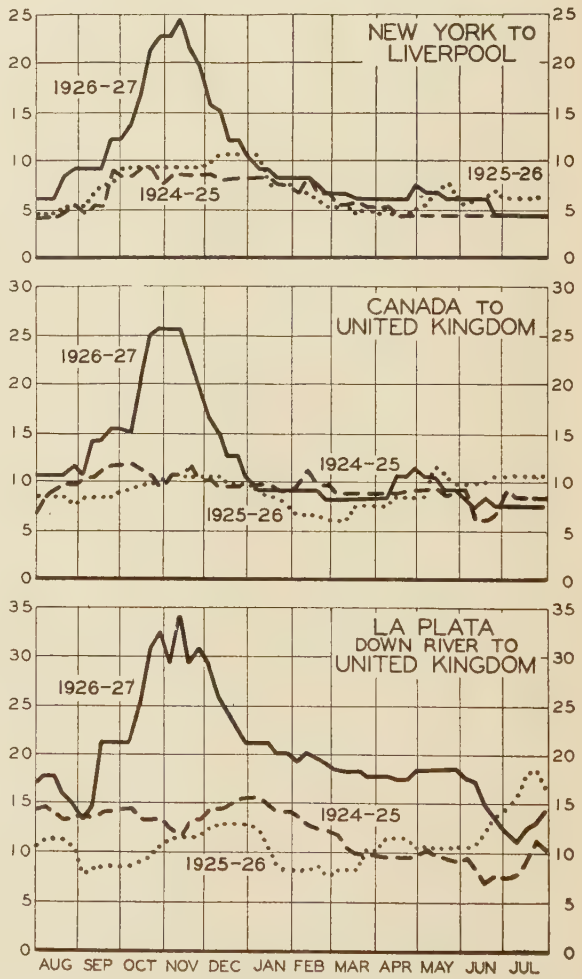
the past four years. There is normally a seasonal increase in August–November as newly harvested North American crops are exported; a decline in November–January when lake navigation closes; an increase to a February or March peak following harvest in the Southern Hemisphere; and a gradual tapering off, interrupted by a minor peak in April or May as lake navigation opens and Canadian wheat is released. But this broadly typical movement is altered by particular developments in every year. Low prices and poor crop prospects in Europe gave rise to exceptionally heavy shipments in March–June 1924. Sharply rising prices restricted exports in November–December 1925. Unusually late opening of lake navigation caused the spring peak of exports to be higher and later than usual in 1926.

In 1926–27, however, an extraordinary advance and decline in ocean freight rates was the cause of the peculiar course of exports. The course for the year as a whole was profoundly disturbed. Exportation in September–November 1926 was abnormally restricted, not only because a full quota of ships was not available, but also because importers bore the incidence of the greatly increased cost of transportation and consequently restricted their purchases. In subsequent months declining prices encouraged importers to make up arrears, and the mid-winter movement was both extraordinarily heavy and unusually prolonged. In effect, a fair proportion of the normal exports of the first half year was postponed until the second half.

The course of ocean freight rates on wheat, on three important routes, is shown in Chart 4. The primary cause of the extreme fluctuation—on the New York–Liverpool route, an advance of nearly 20 cents a bushel in three months—was the British coal strike. For some months after the beginning of the strike on May 1, 1926, rates continued at approximately normal levels, and disturbances in the movement of wheat and flour were too slight to attract marked attention. But in September there occurred a rush for tonnage to transport coal from the United States to Great Britain in anticipation of winter requirements. Rates on wheat rose sharply on all routes[1] as tramp steamers ordinarily available for the transportation of wheat were chartered for the movement of coal. The decline began in mid-November with the return of British miners to work and a slackening of the

CHART 4.—OCEAN FREIGHT RATES ON WHEAT FROM VARIOUS EXPORTING CENTERS TO THE UNITED KINGDOM, WEEKLY FROM AUGUST 1924*

(U.S. cents per bushel)



* Data are Friday rates from *International Crop Report and Agricultural Statistics*, converted from shillings and pence at current rates of exchange. New York–Liverpool rates are for parcels in liners; others for cargoes.

demand for transportation of coal to the United Kingdom. On North Atlantic routes the decline was as sudden and extensive as the advance; and approximately normal rates prevailed by January. But since reallocation of tonnage required more time

[1] See Appendix Table XXII.

on longer routes, transportation charges on wheat shipped from Argentina and Australia remained abnormally high for some months. The exceptionally large supplies of wheat (and of maize in Argentina) requiring shipment in these countries contributed toward maintaining rates at high levels.[1]

With ocean freight rates at discouragingly high levels, importers sought for wheat in near-at-hand sources. As a result, exports from Hungary and Jugo-Slavia were concentrated in the first four months of the year somewhat more heavily than usual; and net exports were made from Algeria, Tunis, and Poland, though these countries were net importers after December.[2] The advance in ocean freight rates caused losses to exporters in several countries (including, it is reported, the Canadian Wheat Pool) who had made sales for deferred delivery abroad without having engaged charters, and who were later compelled to pay high rates in order to keep their contracts.

Certain minor features of the movement in 1926–27 deserve brief mention. The mid-winter rise began earlier than usual, as a result of early harvests in both Australia and Argentina. Up to December these countries exported unusually small quantities, since the Australian carryover into 1926–27, following the small crop of 1925, was very small, and the fairly large Argentine carryover consisted chiefly of poor wheat. With lake navigation opening on April 18, about a week earlier than usual and nearly a month earlier than in 1926, the spring peak of exports came early, especially by contrast with 1926. The decline in shipments at the end of the year was particularly sharp, partly because the earlier figures had been so high, but partly because heavy arrivals coupled with higher prices accompanying delayed seeding in the North American spring-wheat belt caused importers to restrict their purchases drastically.

Exports from the United States were exceptionally large in August, as a result of the early harvesting and rapid marketing of winter wheat in the southwest. Exports from American gulf ports, largely of hard winter wheat, were nearly 70 million bushels larger than in 1925–26, while Pacific coast ports handled the largest quantity in any one of the past five years except 1923–24.[3]

Other noteworthy features of the export movement from the United States were the small shipments of hard red spring and durum wheat as a result of the short crop in the northwest, and the unusually large exports of soft red winter.[4] American imports of Canadian wheat for consumption, duty paid, were less than half a million bushels, despite the short crop of American spring wheat. Imports from Canada for milling in bond, 13.2 million bushels, were small,[5] partly because of the abundance of hard red winter wheat of excellent quality, partly because Canadian wheat of good quality was high in price.

Despite a larger crop in Alberta, the movement of Canadian wheat from Vancouver was only 40 million bushels as compared with 59 million in 1925–26, because of a more restricted demand from the Orient and a shortage of tonnage caused by the exceptional demand for ships on Atlantic routes. The proportion of Canadian wheat shipped overseas from United States ports, somewhat over 50 per cent of the total, was about as large as usual.[6]

[1] For a more detailed analysis of the causes and effects of the advance in ocean freight rates, see WHEAT STUDIES, III, 92 f., 152–56, 271 f.

[2] See Appendix Table XXI, which shows exports and imports of important countries by months.

[3] The following data in million bushels, summarized from data of the U.S. Department of Commerce, show the quantities of wheat (including flour) exported from groups of customs districts for the past five years ending June 30:

	1923	1924	1925	1926	1927[a]
Canadian border and lake ports	32.6	18.3	56.0	21.3	24.6
Atlantic Coast	84.8	42.3	84.0	40.9	59.1
Gulf Coast	63.9	32.1	91.9	12.0	80.5
Mexican border	1.1	2.5	.4	1.3	7.1
Pacific Coast	39.5	64.7	28.5	32.5	47.9
Total	221.9	159.9	260.8	108.0	219.2

[a] Figures for 1927 are preliminary with respect to accurate distribution to the several customs districts. The figure for exports across the Mexican border has not yet been published, and here signifies merely exports not officially allocated to other customs districts.

[4] See Appendix Table XX, which shows exports of wheat from the United States by classes. It should be observed, however, that accurate year-to-year comparisons of the quantities of the several classes of wheat exported are impossible, since so much wheat remains unclassified. Exports of durum wheat especially are understated.

[5] See Appendix Table XIII.

[6] See Appendix Table XIV.

IV. STOCKS AND CARRYOVERS

A Broad View

Large additions to the world stocks of wheat and flour were made during the crop year 1926–27. Carryovers in the principal exporting countries and afloat for Europe, as summarized in Table 5, show an increase of over 50 million bushels. This increase reflects chiefly the replenishment of stocks abnormally depleted at the close of 1925–26, though stocks at the end of 1926–27 were apparently somewhat above normal. From

Table 5.—Approximate Carryovers of Wheat in Exporting Countries and Afloat, August 1, 1922–27*

(Million bushels)

Location	1922	1923	1924	1925	1926	1927
United States	130	153	167	136	111	138
Canada	36	29	41	26	35	48
Argentina	66	56	63	57	67	61
Australia	27	42	38	36	30	41
Afloat for Europe	49	39	42	33	39	46
Total	308	319	351	288	282	334

* Summarized from Appendix Tables XXVI and XXXII; includes some estimates, as indicated in notes to these tables. United States data as of July 1.

essentially the same cause—abundant crops in exporting countries—a similar but not quite so extensive upbuilding of exporters' stocks occurred in 1923–24. In contrast, a sharp reduction occurred in 1924–25 as a result of short crops and high prices. Large variations in carryovers may appear from year to year, chiefly but not entirely localized in North America, where storage facilities are furthest developed. Under special circumstances these variations are significant in their bearing on current analyses of the world wheat situation. At present (November 1927), for example, students and traders are anticipating world crops in 1927 of much the same size as those of 1926; but the fact that much larger initial stocks of 1927–28 constitute a bearish element in the situation is frequently ignored.

Unfortunately it is impossible at present to secure a more comprehensive comparative statement of the world carryover than that displayed in Table 5. No figures are recorded for stocks in China, India, Russia, North Africa, and most European countries. Hence year-to-year comparisons of world stocks cannot be definitive, since neither the magnitude of stocks in these areas, nor the extent of their variation, nor their tendency to vary directly or inversely with exporters' stocks, is known. But indirect evidence suggests that stocks for the world as a whole (Asia and Russia disregarded) were much as Table 5 suggests—distinctly low on August 1 in 1925 and 1926, distinctly high on August 1 in 1924 and 1927.

Somewhat more definite statements are possible concerning carryovers into and out of 1926–27. Carryovers out were much larger than carryovers in, not only in afloat positions and in exporting countries (except Argentina, where, however, quality was much better), but also in the principal importing countries of Europe. Stocks of import wheat were apparently considerably larger, and of domestic wheat probably no smaller. Stocks in Russia were larger at the end of the year than at the beginning; only in Spain and the Danube basin were they notably smaller, and in these countries the position was of little significance because Spain neither exports nor imports appreciable quantities of wheat except for imports in years of bad crops, while stocks in the Danube basin were of poor quality in both years. On the whole, the enlargement of world stocks during 1926–27 was more noteworthy than may be inferred from the data shown in Table 5.

Outward Carryovers in North America

Certain special influences apart from the general effect of large crops in increasing world stocks were operative in particular countries.

The United States carryover out[1] reached 138 million bushels as of July 1, 1927, on the

[1] Comparisons of total United States carryovers except for 1926 and 1927 cannot be made definitive. Estimates of stocks in country mills and elevators were made on a new basis for 1926 and 1927. Prior to July 1, 1925, data on city mill stocks are not available. Inclusive and comparable information on United States stocks will be available only when the U.S. Department of Agriculture data on commercial visibles, begun in August 1926, have been collected for several years. For details of our calculation of United States stocks, see notes to Appendix Table XXXII.

whole apparently about an average figure for post-war years, but some 27 million bushels above the exceptionally low figure for 1926. Stocks in country mills and elevators were probably the lowest in six years. Neither stocks on farms nor commercial visibles were notably high, though they exceeded the low figures of 1926. The comparatively large total carryover was due chiefly to the exceptionally large quantities of wheat and flour in the hands of city mills—some 63 million bushels as against 45 million in 1926[1] and 42 million in 1925. Comparisons of city mill stocks are shown in Table 6.[2] The size of these stocks reflects

TABLE 6.—SUMMARY OF CITY MILL STOCKS JUNE 30, 1925–27*

Item	1925	1926	1927
Reported stocks of wheat...	32.31	35.83	52.59
Of flour as wheat.....	15.73	14.67	16.76
Total.....	48.04	50.50	69.35
Items included in carryover otherwise reported.....	5.60	5.52	6.44
Balance.....	42.44	44.98	62.91

* Condensed from Appendix Table XXIV.

the high quality of the winter-wheat crop of 1926, and the low levels of premiums for protein content throughout the crop year. Mills built up their stocks of old-crop wheat toward the end of the year in view of the probabilities that the crop of 1927 would prove less satisfactory for milling, and that relatively high premiums for protein content would prevail. No incentive to build up stocks was provided by the relation of near to distant futures. Thus the situation differed sharply from that at the close of 1923–24, when the relations of futures prices were such as to encourage holding of grain by mills.[3]

The size of the reported carryover out of 1926–27 reflects upon the accuracy of the crop estimate. The sum of dependable figures for net exports, seed requirements, consumption, and stocks subtracted from the figure for supplies available during the year, leaves a residual of only 20 million bushels for feed and waste.[4] This figure, like the figure of 31 million bushels for 1925–26, appears impossibly low if feed and waste amounted to 70–92 million bushels in the years 1922–25; and figures for feed and waste ought to reach 55–65 million bushels for crops ranging from 700 to 800 million, if the Department of Agriculture's estimate of the normal use for feed on farms (8.1 per cent of the crop) is correct.[5] The crops of 1922–24 were perhaps slightly overestimated; those of 1925 and 1926 seem to be underestimated. But so long as precise information on the use of wheat for feed is lacking, precise statements of errors in crop estimates cannot be formulated.

Canadian carryovers,[6] unlike the American in some respects, are officially estimated for all their components, account for wheat in all significant positions, and may be accepted as reasonably accurate unless the control of a large proportion of the crop by the Pool has led to difficulties of estimation. The total carryover reached 50.6 million bushels, exceeding the previous record of 45 million after the 474 million bushel crop of 1923, and larger than that of last year by 15 million bushels. The quantity in terminal elevators, 37 million bushels, was some 10 million bushels larger than in any other year. The evidence suggests that the Canadian Pool followed a policy of restricted sales, especially during the winter months, in anticipation of higher prices in the spring and/or the crop year 1927–28. It is the general view of traders that a policy of restriction was followed; there is no

[1] The figure for 1926, and the visibles figure as well, probably included some new-crop wheat, and the same was perhaps true on July 1, 1927, though to a lesser extent.

[2] The figures for city mill stocks on July 1, 1925 and 1926, were obtained by the Census Bureau from mills producing 87.4 per cent of the total flour output of the United States as determined by the biennial census of 1923; on July 1, 1927, from mills producing 90.1 per cent of the total output as determined by the census of 1925. Hitherto it has been our practice to raise the city mill stocks figures by the indicated percentages in order to secure as complete a statement of stocks as possible. But in view of the desirability of presenting a total United States stocks figure including no duplications, and the probability that some duplication exists between the raised figures and official estimates of stocks in country mills and elevators, we have discontinued the practice. See note to Appendix Table XXXII.

[3] See WHEAT STUDIES, II, 31.

[4] See Appendix Table XXXII.

[5] *Agriculture Yearbook, 1923*, p. 660.

[6] See Appendix Table XXIII. The figures shown in this table run slightly higher than the carryover figures shown in Table 5 and Appendix Table XXXII.

doubt in trade circles that the Pool owned most of the carryover;[1] though much of the carryover was of poor quality, there is every reason to suppose that more wheat would have been sold if prices had been made more attractive to buyers. Apparently the Pool's policy was well advised; for, according to the recently issued *Directors' Report,* some 32 million bushels of wheat were sold in August and September 1927. Presumably these sales brought prices higher than prevailed in the winter months.

Southern Hemisphere Stocks

Australian and Argentine stocks have never been estimated directly, either officially or unofficially; hence they must be calculated by reference to statistics of disposition. For both countries fairly reliable estimates of net exports, seed requirements, and consumption for food are now available; and it is clear that feed and waste is a small item in both countries, notably Australia. Our revised estimates for these items of disposition, with detailed comments, are given in Appendix Table XXXII.

Independent calculations of all items of disposition for Australia yield a figure for stocks on August 1, 1927, of 41 million bushels, some 11 million higher than the figure for 1926, but not far different from those of 1922–25. The exportable surplus presumably amounted to some 18 million bushels, of which about 13 had been shipped by November 1, 1927. For each year up to 1926–27, our estimates of stocks, though calculated as residuals, are consistent with the reported volume of exports from August 1 to December 31, appropriate allowances for domestic consumption during these months, and the assumption that stocks of old-crop wheat on December 31 each year are at a fixed minimum of 5 million bushels. Our calculations do not call in question the accuracy of Australian crop estimates during the past five years.

The stocks position in Argentina is more difficult to evaluate on account of the poor quality of the crop of 1925–26. Unquestionably more than the usual amount of wheat was used for feed and waste in the calendar year 1926. Consequently it is necessary to estimate this item higher for the past two years ending August 1 than for the three preceding. Seed requirements per acre were presumably also above normal in 1925–26 from the same cause; and during the calendar year 1926 more than the usual amount of wheat was required per ton of flour milled. With adjustments for these factors we are disposed to estimate stocks on August 1, 1927, at 61 million bushels as compared with 67 million on August 1, 1926. But the stocks of 1927 must have contained a considerably smaller quantity—perhaps a negligible quantity—of poor quality wheat than was the case in 1926, for, according to reputable millers and traders in Europe, the mixing of poor wheat from the 1925 crop with good wheat from the 1926 crop was more extensively practiced throughout the year than had been thought possible. Hence the Argentine carryover into 1927–28, though smaller in quantity than that of 1926–27, in effect bulked larger as a potential source of supply for purchasers.

Thus in all exporting countries, considered not only as a group but separately as well, carryovers out of 1926–27 were in fact or effect considerably larger than carryovers in. Quantities afloat for Europe were also larger;[2] Broomhall placed the figure at 46.1 million bushels, the highest since 1922, and 7.5 million above the figure for August 1, 1926. Stocks afloat contained more than the usual amount of wheat from the Southern Hemisphere, since July exports from North America were unusually small and May–July exports from Argentina and Australia were unusually large; the size of the afloat figure, indeed, was due chiefly to the exceptionally heavy end-year exports from the Southern Hemisphere.[3]

European Stocks and Carryovers

European stocks consist of both imported and domestic wheats, and data are not reported for either type in most countries. Nevertheless certain significant conclusions, especially respecting the past two years,

[1] Some responsible traders firmly believe that the carryover in the hands of the Pool was nearer 60 than 50 million bushels; but the Pool sales in August and September of 31.6 million bushels, and the carryover into 1927–28 of 7.4 million, imply an August 1 Pool carryover of 39 million bushels. See *Directors' Report, 1926–27,* p. 3.

[2] See Table 5 and Appendix Table XXVI.

[3] See Appendix Table XXI.

may be drawn on the basis of available evidence, in some part statistical.

In Great Britain stocks of domestic wheat are of minor importance, since the native crop provides only about a fifth of the wheat consumed annually. Stocks of import wheat were unquestionably large on August 1, 1927. Port stocks were estimated at 7.8 million bushels as compared with 4.3 million on August 1, 1926.[1] The figure for 1927 was about average for recent years. But the generally expressed belief of traders that millers held large stocks, and the exceptionally heavy imports of the last five months of the year, lead to the probability that the British carryover of import wheat was the largest in the past five years except on August 1, 1924.

Carryovers of domestic wheat are of major significance in France. Private investigators estimated total French supplies of old-crop wheat in all positions at 34–37 million bushels on August 1, 1927.[2] Similar estimates have not been made for earlier years; but observers are agreed that stocks have not been so large for some years, and that the carryover out of 1925–26 was very much smaller. The outward carryover of import wheat (including flour) officially reported in custom-house warehouses was also large as compared with the carryover in, though in absolute amount the quantities are never large.[3] The size of the carryover, taken in conjunction with data on domestic utilization, supports the inference that the crop of 1926 was officially underestimated.[4]

Stocks in Antwerp at the end of July, according to the *Corn Trade News,* were 1,858 thousand bushels in 1927 as against 558 thousand in 1926. For other countries statistical data are lacking. In Germany the position was apparently not greatly different at the beginning and end of the crop year; domestic stocks were small (as is indicated by the absence of price quotations for native wheat at Berlin in June and July of both years), while stocks of import wheat were fairly high in both years because of heavy imports late in the year. Italy, where domestic wheat supplies are of large importance, is reported to have had larger stocks in 1927 than in 1926; and the inference is supported by statements that even late in the crop year marketing by farmers was so free that native wheat was appreciably cheaper than imported. Stocks of import wheat, however, were perhaps no larger in 1927 than in 1926. In the Danubian countries, Roumania perhaps excepted, supplies were probably smaller in August 1927 than in 1926; but available export surpluses were of poor quality in both years. If the Russian crop estimate is trustworthy, the fairly high stocks at the end of 1925–26 must have been further increased in 1926–27; and consumption and stocks alike perhaps approached pre-war levels during the past crop year. Central European countries apparently had small stocks, but such is probably the normal condition.[5]

On the whole it appears certain that European wheat stocks of significance to international trade and prices were considerably larger at the end of the crop year than at the beginning, and perhaps—especially if Russian stocks are counted—the largest in post-war years, not excepting 1923–24.

Visible Supplies

The weekly course of visible supplies throughout the year presents certain features of interest and significance. Data for the past three years appear in Chart 5, p. 22.

The course of visibles afloat and in ports of the United Kingdom was distinctly peculiar practically throughout 1926–27. The movement each year naturally coincides roughly with the course of wheat shipments except for a lag of two to four weeks, since the volume of wheat afloat depends upon the volume of wheat exported. The lag is naturally greater in the latter half of the year, when shipments from the Southern Hemisphere, which are longest afloat, bulk largest. As was true of the course of ship-

[1] See Appendix Table XXVI.

[2] The estimate of M. Sicot was 34 million, that of the *Bulletin des Halles,* 37 million.

[3] The totals for the past four years, in thousand bushels as of July 31, were as follows: 1924—1,630; 1925—1,321; 1926—536; 1927—1,436.

[4] See below, p. 44.

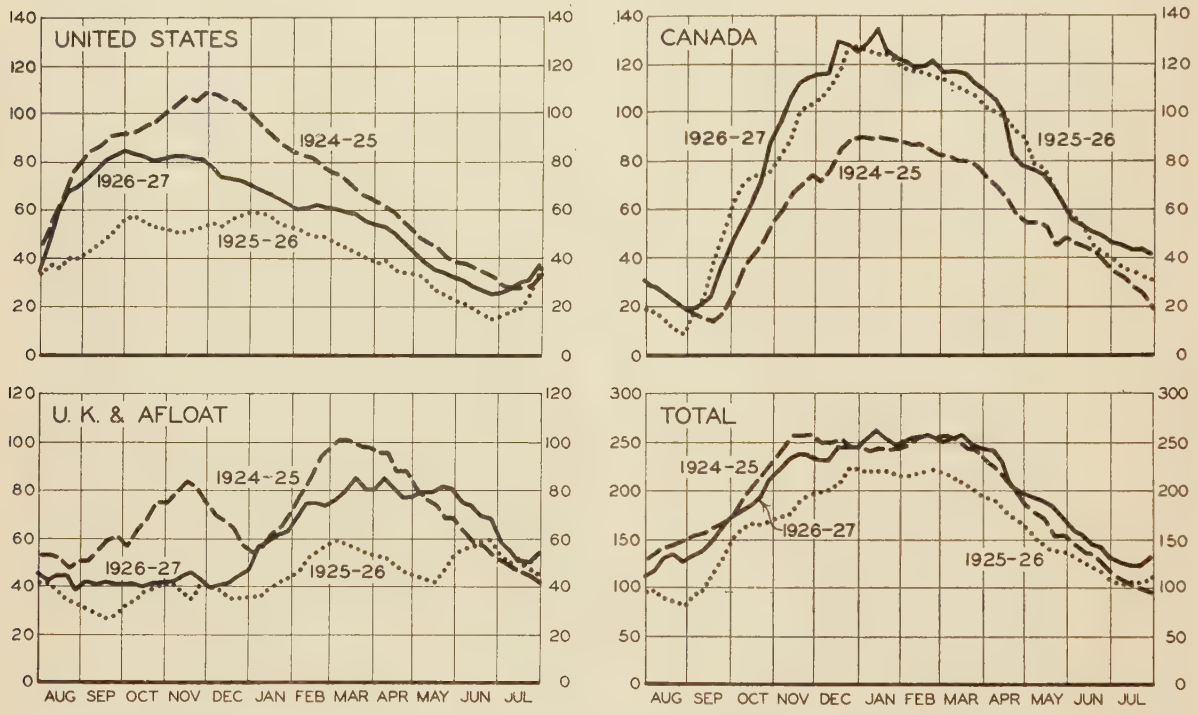
[5] For example, *The Polish Economist,* October 1927, speaks of Polish stocks of less than a million bushels at the end of 1925–26 as large; and at the end of 1926–27 Polish stocks were reported by the *Corn Trade News* (quoting figures printed in the *Ost Express*) as 2.9 million bushels, with 1.2 million in farmers' hands. Spanish stocks, which were probably somewhat smaller in August 1927 than in August 1926, ordinarily have little significance for the world wheat situation.

ments, the course of visibles afloat in 1926–27 was disturbed by the abnormal developments in ocean freight rates. The normal peak of November (normal at least in years when North American crops are large and international trade is heavy) did not appear; and visibles in the latter half of the year ran exceptionally high for some weeks. It is significant to observe, however, that the peak of visibles in March 1927 was much lower than in March 1925, principally because Australia, Argentina, and India were contributing relatively large exports in December–February 1924–25.

The course of United States visibles (Bradstreet's) was also notably peculiar by contrast with 1924–25. Visibles higher in 1926–27 than in 1925–26 were natural in view of the much larger crop. But from September 1 to the end of June in 1924–25, visibles ran from 5 to 25 million bushels higher than in 1926–27, despite crops of similar size in the two years.[1] The explanation lies largely in the smaller spring-wheat crop of 1926–27; for the spring-wheat crop appears more largely in the visible than does the winter-wheat crop. Another factor was the more rapid marketing by farmers induced by the higher prices of the former year, notably in October and November. Farmers were in a much better financial position to hold wheat in 1926–27 than in 1924–25, and were disposed to do so in view of prices lower than those of the two preceding years. As a consequence receipts of wheat at primary markets ran lower than in 1924–25 throughout the year, especially during November–February;[2] while stocks of wheat on farms and in country mills and elevators on March 1 totalled 216 million bushels in 1927 as against 180 million in 1925. Visibles reached the low point of the year toward the end of

CHART 5.—VISIBLE WHEAT SUPPLIES IN THE UNITED STATES, CANADA, UNITED KINGDOM PORTS, AND AFLOAT TO EUROPE, WEEKLY FROM AUGUST 1924*

(Million bushels)



* Data from *Price Current-Grain Reporter* and *Canadian Grain Statistics.*

[1] The official figures are for 864 million bushels in 1924, 833 in 1926; but the former is probably slightly too high, the latter somewhat too low. See above, p. 19.

[2] See Appendix Table XV.

June 1927, some weeks earlier than usual. Such was also the case in 1926; and July receipts at primary markets, 77 million bushels in 1926 and 59 million in 1927, were relatively heavy in both years.[1] The effective though not the actual maturity of the wheat crop has apparently been advanced a few weeks through increasing use of the small harvester-thresher combine.

Throughout most of the year Canadian visibles ran higher in 1926–27 than in the preceding year, though the crop of 1926 was slightly smaller than that of 1925. In late October and November the figures ran higher than in any post-war year, reflecting on the one hand the retarded export movement caused by high ocean freight rates, on the other the rapid movement from farms in response to requests of the Pool that members move forward rapidly the large quantities of damp wheat. During the subsequent months of closed navigation visibles were prevented from rising higher only by a relatively heavy movement of wheat by rail to the seaboard.[2] Early closing of navigation on December 12 contributed to swell the visibles figures in December–April; but subsequent to the opening of navigation on April 18 a sharper decline than usual took place.

V. WHEAT PRICE MOVEMENTS

The Level of Prices

The general level of prices for wheat moving in international trade in 1926–27 was slightly lower than in the two preceding years, but much higher than in 1923–24, the year of lowest prices since the war. On the basis of customs returns, importers of the United Kingdom—the greatest wheat-importing country—paid, on the average, $1.64 per bushel for wheat from all sources in 1926–27, as against $1.70 in 1925–26, $1.77 in 1924–25, and $1.22 in 1923–24.[3] The same fact appears with respect to prices paid for parcel lots of wheat in the several British ports, as shown in Chart 6 (p. 24).[4] Similar relationships in price levels during the past four years would presumably be observed if data on quantities and values of imports could be secured for other importing countries. As we have seen, the distribution of world crops between exporting and importing countries dominates price levels in different years.[5] In 1923–24, exporting and importing countries alike had large crops, and prices were low. The reverse was true in 1924–25. In 1925–26 Europe had very large crops, but exporting countries had not. In 1926–27 European crops were smaller, but crops in exporting countries were enough larger more than to offset the reductions in Europe. The international level of prices would probably have been somewhat lower in 1926–27 except for exceptionally high ocean freight rates. Increased costs of transportation were borne chiefly by importers, not by exporters;[6] and British parcels prices consequently include a large proportion of these increased costs. Furthermore, exportable surpluses were more tightly held than heretofore, especially by contrast with 1923–24. Wheat pools controlled larger proportions of the Canadian and Australian crops, while farmers in the United States were in a more

[1] By comparison, receipts at primary markets in July 1922–25 ranged from 34 to 42 million bushels.

[2] During the past four crop years, since Vancouver assumed importance as a port of export, shipments of wheat from Fort William and Port Arthur by rail have been as follows, in million bushels:

1923–24	7.9	1925–26	9.7
1924–25	7.3	1926–27	13.6

[3] Figures obtained by dividing values of annual wheat imports of the United Kingdom by quantities of wheat imported.

[4] The series of parcels prices, though by no means satisfactory in all respects, may be regarded as the best available generalized description of the level and course of what may be called international wheat prices. Except for different freight charges, other importing countries presumably pay c.i.f. prices for particular sorts of wheat identical with prices paid for the same sorts by the United Kingdom. The British price misrepresents the international price in so far as other importers purchase different sorts of wheat, or the same sorts in different proportions. Our compilation of parcels prices for the United Kingdom further provides a description of British import prices faulty in so far as the omission of cargo prices, occasional inclusion of parcels to be shipped and afloat as well as spot, and absence of accurate weighting, give rise to misrepresentation. Such tests as we have been able to make indicate that correction for these factors would not yield a greatly different picture.

[5] See above, p. 9.

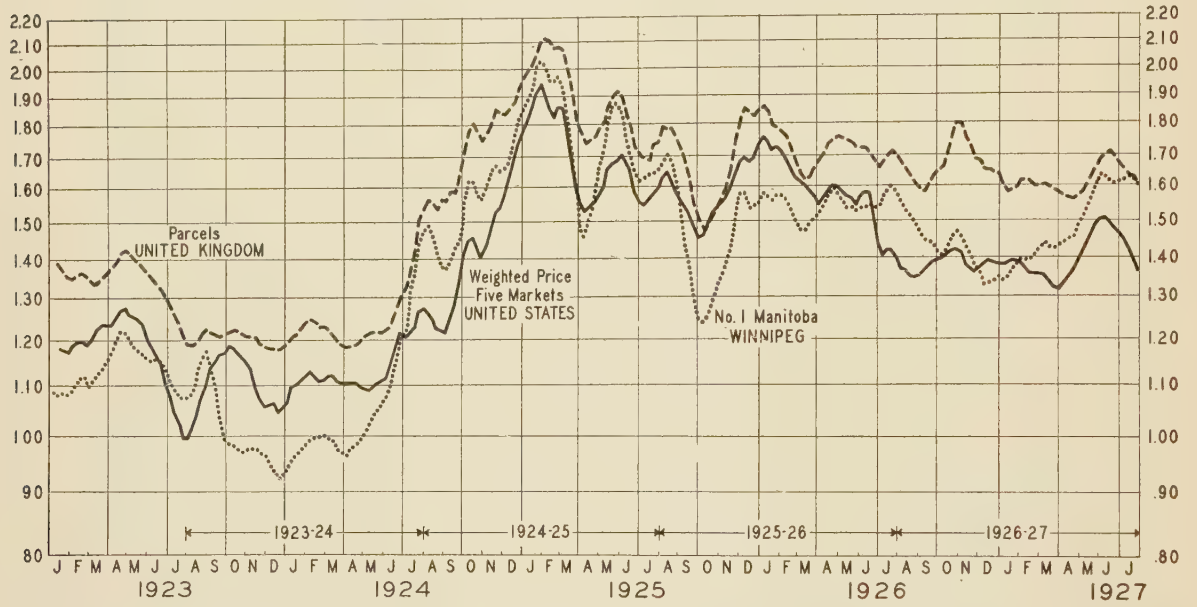
[6] The relations of near and distant futures prices in Liverpool during the first half of the year support this inference. See below, pp. 27 f., and Wheat Studies, III, 155 f.

favorable financial position; and European countries were better able to buy. The unusual delay to spring-wheat planting in North America in 1927 raised the price level of 1926–27 fortuitously. Had similar conditions prevailed in these two years price levels presumably would not have shown such wide discrepancies.

because Canada had crops of similar size in the two years. A short crop in the United States in 1925–26 kept American prices relatively high in that year, and in 1926–27 international prices were kept relatively high by the freight situation. A further illustration appears in the relatively low Canadian prices of 1923–24 following the huge crop

CHART 6.—WEEKLY AVERAGE CASH PRICES OF ALL CLASSES AND GRADES OF WHEAT IN FIVE PRINCIPAL UNITED STATES MARKETS, OF NO. 1 MANITOBA NORTHERN IN WINNIPEG, AND OF SALES OF PARCELS OF ALL CLASSES OF WHEAT IN UNITED KINGDOM, FROM JANUARY 1923*

(U.S. dollars per bushel; 3-week moving average; logarithmic vertical scale)



* Data from *Crops and Markets*, direct from U.S. Department of Agriculture, from the *Grain Trade News*, and from *London Grain, Seed and Oil Reporter*. United States prices are weekly weighted averages from six markets since the first week in January 1927.

The prices of wheat sold in exporting countries, however, do not remain from year to year in precisely the same relationship to international prices. In a broad view, as appears from Chart 6, international prices and prices in the great exporting countries ordinarily move in the same general direction from month to month and from year to year. But year-to-year changes in levels may be much greater in one country than in another or than in international price levels. Thus United States weighted average prices in 1926–27 ran further below prices in 1925–26 than did Canadian prices of No. 1 Northern; and Canadian prices ran somewhat further below than did international. The "normal" shift in levels, so to speak, occurred in Canadian prices, of 1923, and the relatively high prices in 1924–25 following the short crop of 1924.

International wheat price levels are ordinarily of some significance in European importing countries, since, as in exporting countries, domestic wheat prices move, though by no means closely, with the international. Yet significant exceptions appear. French millers paid not less, but much more per bushel for French wheat in 1926–27 than in 1925–26, and somewhat more than in 1924–25. In 1925–26 the large crop and negligible import requirements kept prices below the international price level and rendered the tariff ineffective; but in 1926–27 the exceptionally short crop of 1926–27 reversed the situation. Nor was 1926–27 a year of comparatively low prices for do-

mestic wheats in Italy and Germany, where crops were sufficiently small to permit the enhancement of prices behind high tariffs.[1]

The price of British import wheat as shown in Chart 6 is, of course, an average price—approximately the center of a rather wide range of prices for specific types and grades of wheat. There is a considerable degree of change, both from month to month and from year to year, in the positions which particular types of wheat occupy, relative to other types, within this range of prices. Usually No. 1 Northern Manitoba and Australian wheats command the highest prices because of their intrinsic value for milling purposes. Throughout 1926–27 prices for the several types of wheat ran closely together; there was no such divergency as appeared with respect to Argentine wheat in 1925–26, when poor quality resulted in a heavy discount at Liverpool. From February 1927 to the end of the year, however, No. 1 Northern Manitoba sold at an unusually high premium because this grade, in short supply in the Canadian crop of 1926, was relatively scarce compared with other varieties. No. 3 Northern Manitoba, on the other hand, sold at lower prices even than No. 2 Winter and Rosafé wheats during parts of March and April.[2]

The General Course of Prices

Comparative stability was the outstanding feature of the course of prices in 1926–27. The major fluctuations of wheat prices during 1926–27 are shown in their broad outlines in Chart 6, and in greater detail by daily quotations of futures prices in the world's leading markets in Chart 7 (p. 26).[3] Fluctuations were much less extensive than in 1924–25 and 1925–26, and on the whole not greater than in 1923–24 (except for the advance in Liverpool due to the freight situation). During 1926–27, as we have seen, there were no outstanding reversals in prospects for 1926 crops. Crops which promised well fulfilled expectations; minor disappointments in Europe were offset by minor improvements elsewhere; conspicuous uncertainties in the crop situation were not present until the end of the year; and the international position was continuously fairly easy. Speculation—certainly in the United States, and presumably elsewhere—was at a much lower level than in the two preceding years, though higher than in 1923–24.[4]

In a broad view, prices in all markets declined throughout August until early September; rose sharply until about October 22; and declined sharply in November. The course from December to April was comparatively stable in all markets, but significant differences appear as different markets and different price series are considered. A marked increase in May culminated about the 28th of the month, followed by a decline to slightly lower levels in June and July.

The decline in August 1926 was due in part to unexpectedly good threshing returns in the United States winter-wheat belt and large marketings accompanied by increasing visible supplies; in part to the breaking of the drought in Canada and increasingly good prospects in that country. After September 4 unfavorable threshing weather in Canada and Europe combined with reductions in European crop estimates and restricted marketing after October in the United States to cause an advance, which was accelerated after mid-September by the advance in ocean freight rates. The latter influence had its major effect on Liverpool prices, but prices in Chicago and Winnipeg moved in sympathy. Reports of frost in Argentina contributed to the October advance a few days before the 22nd of the month. The November decline was due predominantly to confirmation of a crop of large size if not of excellent quality in Canada,[5]

[1] See Appendix Table XXIX for monthly prices of native wheats in European countries during the past three years.

[2] For the price comparisons on which this paragraph is based, see Appendix Table XXVIII, and charts in Wheat Studies, II, 42, and III, 116.

[3] A small beginning was made in futures trading at Melbourne, Australia, in 1926–27, but its success remains to be seen. The Seattle futures market has become established. Another development in 1926–27 was the institution of a March future in Chicago. Trading in futures on the New York Produce Exchange, instituted in 1926, has been of smaller volume than was hoped for.

[4] The average daily volume of futures trading on United States markets was 42 million bushels in 1926–27, as against 61 in 1925–26, 63 in 1924–25, and 24 in 1923–24. See Appendix Table XXX.

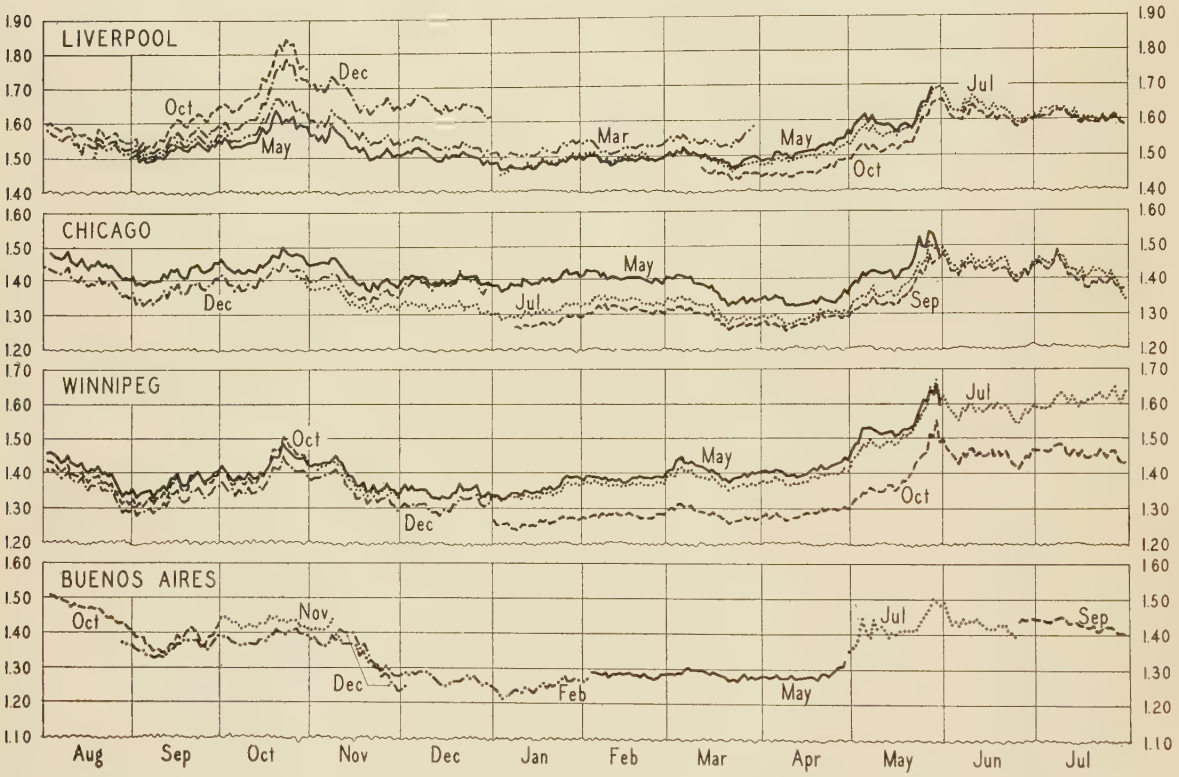
[5] The sharpest break during November occurred in the three days following appearance on November 10 of the Canadian official estimate of a crop of 406 million bushels. The previous estimate (September 10) had been 399 million; but many traders expected the November estimate to be smaller rather than larger.

and to increasing certainty that Southern Hemisphere crops would prove large, that ocean freight rates would decline, and that Danubian and Russian exports would not disappoint reasonable expectations.

Throughout the winter months, December–April, prices in different markets and of different sorts, in the absence of noteworthy changes in crop prospects, did not fluctuate together. The year's low point for futures in Buenos Aires ($1.21 per bushel) was reached on January 4 with the advent of the new crop; for a month prices advanced slightly, to remain at a level of $1.28–$1.30 from February to late April. January was the month of lowest cash prices in Buenos Aires.[1] In Winnipeg the year's low point for May future and cash prices alike came also at about January 4, but thereafter a gradual advance occurred. But in Liverpool futures prices were within a cent as low on March 23 as on January 4; the May future in Chicago from late March to late April was lower than on January 3; cash prices in the United States reached their low points in March and April;[2] British parcels prices were also lower in late March and April than at any other time during the year; and Australian export prices were lowest in March.[3] Hence the course of "world" prices during these months cannot be described without qualification; special conditions in particular countries, too numerous to receive detailed consideration here, made for diverse price movements in the absence of striking changes in the international position. Broadly speaking, however, one may say that a lower level of wheat prices prevailed in December–April than in the latter part

Chart 7.—Daily Closing Prices of Principal Wheat Futures in Four Leading Markets, August–July 1926–27*

(U.S. dollars per bushel)



* Data from *Chicago Journal of Commerce* and *Daily Trade Bulletin*, Chicago.

[1] For Barletta wheat. See Appendix Table XXVIII.
[2] See Chart 6, p. 24, and Chart 8, p. 28.
[3] See Appendix Table XXVIII.

of November. Our expectations, expressed in December 1926, were fully borne out with respect to international cash prices, if not with respect to futures prices.

The comparative firmness of United States prices in December–February and of Winnipeg prices in January–April merits brief comment. In the United States there is normally a seasonal upswing in mid-winter, and in part the relative firmness of prices was presumably due to this movement. But the exportation of enormous quantities of wheat prior to December 1, and relatively slow marketing of so large a crop, caused an approach to a domestic basis for prices and deferred the decline until March. The bullish attitude of many American traders may have been a contributing cause.[1] The upward course of prices in Winnipeg after the first of January was perhaps in part a seasonal movement also. But the evidence suggests that crafty merchandising by the Pool combined with an effective shortage of wheat of superior grades was partly responsible. A Winnipeg price series in which sales of wheat grading below No. 3 Northern were given appropriate weighting might fail to reflect the upward movement distinctly shown by prices of wheat futures and of Nos. 1 and 3 Northern.

Crop prospects for 1927 were responsible for rising prices in all markets during May and the latter part of April as well. In the United States, the seeding of spring wheat was delayed by excessive rainfall—in some localities until the end of May, fully a month later than usual—and unseasonable frosts and deterioration from other causes occurred in the southwestern winter-wheat belt. In Argentina a long-continued drought hampered the sowing of winter wheat; and, as appears from Chart 7, futures prices rose much more sharply at Buenos Aires than elsewhere in the first week of May. The May advance in prices was naturally the most extensive in Winnipeg; for in Canada the sowing of spring wheat—a more significant operation in that country than in the United States on account of the shorter growing season—was delayed even further than in the United States. The spring was late; a snowstorm occurred on May 2 and 3; and heavy rains hindered operations throughout the month. A revival of speculative activity, and continued heavy purchases of wheat by European importers, were contributing factors.[2]

The high prices of late May could not be maintained in the face of better weather in North America and Argentina. It became increasingly clear that wheat acreage for 1927 would not fall so low as had been expected. The significance of abundant subsoil moisture for spring wheat in North America was increasingly recognized. European purchasers, faced for the first time in the course of the year with arrivals heavier than could be absorbed by millers, largely withdrew from the market. Nevertheless uncertainties in North American prospects for spring wheat incident to the late seeding and danger of rust, coupled with mediocre prospects in Europe, maintained prices at a level some 10–15 cents higher in June and July than had prevailed in March and April.

Relations of Near and Distant Futures

The relationships of near and distant futures in various markets were in a few instances peculiar in 1926–27. In Liverpool, during the first few months of the year, October and December futures ordinarily carry a high premium over the May when the international position is immediately tight but expected to become easier. Such was the case in October–December both in 1925–26[3] and in 1926–27, but for different reasons. In the former period the international position was tight because available exportable surpluses were small; in the latter period high ocean freight rates were responsible. Furthermore, the premium of October and December futures prices over the May was considerably larger in 1926–27 than in 1925–26. British traders expected British prices to rule lower in the spring than in October–December not so much because larger supplies would be available as because c.i.f. prices promised to be lower when ocean freight rates fell to normal levels. The increasing spread between October and May futures prices in September and October, taken in conjunction with the

[1] See Wheat Studies, III, 284.
[2] See *ibid.*, III, 143, 282 f.
[3] See chart in *ibid.*, III, 112.

fact that May futures prices moved similarly in Liverpool, Chicago, and Winnipeg, argues that British (and presumably continental) importers rather than exporters bore chiefly the increased cost of transportation caused by the advance in ocean freight rates.[1] The Liverpool March future closed well above the May, since arrivals of wheat, though large, had been readily absorbed; but the May closed practically with the July as cash wheat became plentiful following heavy imports and slower absorption of arrivals.

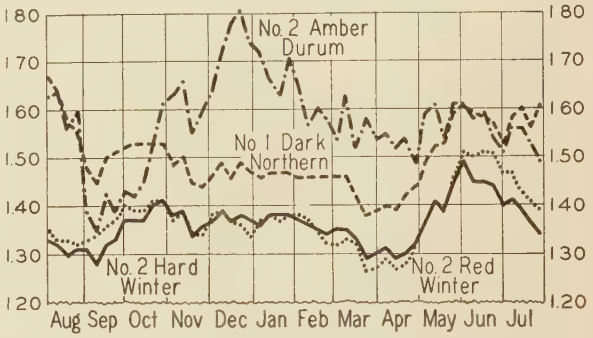
In Chicago the relationships of near and distant futures were on the whole normal; there were no reversed carrying charges such as prevailed in 1925–26,[2] and closing operations were quiet except for breaks in both May and July prices at the close. In Winnipeg the only notable feature was the slightly increasing spread of May and July prices over October during the latter half of the year, probably a result of shortage of deliverable grades from the crop of 1926. In Buenos Aires the December future became a new-crop rather than an old-crop future on prospects of an early harvest, and closed below the February.

United States Cash Prices

The cash prices of representative wheats in the United States stood in markedly different relationships to one another in 1926–27 and 1925–26. Price comparisons for 1926–27 are shown in Chart 8. With short crops in the United States and in Italy and North Africa as well, durum wheat commanded a high premium over other varieties practically throughout the year. In 1925–26 a relatively large crop had given rise to an equally striking discount. No. 1 Dark Northern was 10 cents or more per bushel dearer than hard red or soft red winter wheats. The premium would undoubtedly have been higher had not the excellent quality of hard red winter made substitution for hard red spring feasible to a high degree. Soft red winter wheat failed to secure the premiums prevalent in 1925–26, when the crop was much smaller. The prices of hard and soft red winter moved closely together except in August and September 1926, when wet harvesting weather east of the Mississippi established a small premium on soft red wheat; and in June and July 1927, when crop prospects east of the Mississippi were comparatively poor. No. 1 Dark Northern was at the highest premium for the year in August 1926, before the new crop was harvested; and again in July 1927, because the new crop of winter wheat then beginning to come to market compared less favorably with spring wheat than did the crop of 1926.

Chart 8.—Weekly Average Cash Prices of Typical Wheats in United States Markets, August–July 1926–27*

(U.S. dollars per bushel)



* No. 2 Red Winter at St. Louis, No. 2 Hard Winter at Kansas City, No. 1 Dark Northern Spring and No. 2 Amber Durum at Minneapolis. Data from *Crops and Markets*.

Roughly comparable grades of Canadian and American spring wheats sold at prices considerably less divergent in 1926–27 than in 1925–26. As judged by monthly average cash prices, No. 1 Dark Northern at Minneapolis sold at prices no more than 25 cents per bushel higher than No. 3 Northern Manitoba at Winnipeg during 1926–27. The difference was less than the tariff of 42 cents; hence importation of Canadian wheat for domestic consumption over the tariff wall could not be undertaken with profit. In 1925–26 the margin in favor of American wheat reached 39 cents in October and remained higher than in 1926–27 throughout the year, and at times the margin was so great that imports were feasible. The comparison is of interest chiefly because American hard spring wheat, though definitively on a domestic basis in 1925–26, was nearly so in 1926–27 as well because of the smaller crop. Had not hard red winter wheat proved substitutable in a high degree,

[1] See further Wheat Studies, III, 155.

[2] See Wheat Studies, III, 114.

1926–27 might have perhaps proved another year of wide price margins between No. 1 Dark Northern at Minneapolis and No. 3 Northern at Winnipeg; and No. 1 Dark Northern might again have sold at Minneapolis for prices quite as high as the prices of No. 3 Northern at Liverpool.

European Prices of Native Wheats

It is impossible in limited space adequately to discuss differences in either the level or the course of prices of domestic wheat in European countries. For many countries neither satisfactory price series nor adequate data to explain movements are available, and prices in each country are naturally affected by influences not operative elsewhere. The following figures, monthly average cash prices (January and May 1927) for domestic wheat in various European countries and for British parcels, expressed in United States dollars, serve roughly to illustrate the diversity of price levels and movements.[1]

	January	May
British parcels	$1.58	$1.63
Great Britain	1.55	1.58
Italy	2.13	2.16
France	1.88	1.91
Germany	1.72	1.92
Poland	1.56	1.79
Hungary	1.54	1.66
Roumania	1.37[a]	1.32

[a] March, not January.

Italian native wheat sold at higher prices than in any other country during 1926–27, despite a crop of large size. The high tariff (7.50 gold lire per quintal, equivalent to about 39 cents per bushel) was effective, and slow marketing by farmers throughout most of the year enhanced its effectiveness. Similarly high prices had prevailed in 1925–26 under similar circumstances. In contrast, French prices, next highest to the Italian in 1926–27 as a result of a small crop and tariff protection,[2] had run relatively much lower in 1925–26 on account of a large crop. German prices in 1926–27 were also high, especially toward the end of the year as domestic supplies were exhausted. Throughout most of the year prices were well above the level of 1925–26, principally on account of the smaller crop. In Great Britain domestic wheat sold close to the international cash price level except in August 1926 and June and July 1927, months when the level is seasonally high before new-crop wheat is available. Aside from disturbances caused by special seasonal influences in particular countries, the course of domestic wheat prices in the four great importing countries followed roughly the course of international prices; for the most part, the highest prices of the year were reached in November and May. In Italy and France a notable decline occurred from May to July, in part in accord with the international movement and the advent of new crops, but in part as a result of heavy marketings of accumulations of old-crop wheat. No such decline occurred in Great Britain and Germany, since stocks were exhausted and the new crop was farther from harvest.

Hungarian prices apparently followed the international movement, and at about the same level. In Roumania, however, the poor quality of the crop of 1926 kept prices very low—perhaps the lowest in Europe. Prices ruled low in Poland early in the year and permitted small exports; but increasingly clear evidence of deficient supplies caused a practically uninterrupted rise, amounting to about 30 cents per bushel, between early November and early May.

Returns to Wheat Growers

Since farm prices of wheat in 1926–27 presumably varied from country to country in much the same manner as cash prices, returns to wheat growers must also have varied widely from country to country. On the whole, however, 1926–27 was a reasonably prosperous year for producers. With the world wheat crop ex-Russia of about the same size as in 1925–26, prices were but little lower, and costs of production can hardly have changed substantially. But in the absence of reliable data on farm prices and costs for most countries, little can be

[1] For sources of data on British parcels, see note to Chart 6, p. 24; on English, Italian, French, and German prices, see Appendix Table XXIX. Polish price quotations have been secured from the *Polish Economist;* Hungarian, from *Magyarorszag* (Budapest); and Roumanian, from *L'Economiste Roumaine.*

[2] Total suspension of the duty of 18.2 francs was in effect from July 3 to August 20; from August 20 to October 18 the duty was fully effective; from October 18 to January 1 a partial suspension of 8 francs was permitted; thereafter the full rate was again effective.

said with assurance. By contrast with 1922–23 and 1923–24, wheat production has been distinctly more profitable in practically all countries during the succeeding three years. The year 1926–27, however, does not stand out as exceptional among these three.

In the United Kingdom, changes in prices and in crops have apparently resulted in about the same gross returns to farmers in each of the past three years. Italian farmers, with a comparatively small crop and without tariff protection, had their lowest gross returns in 1924–25. French farmers obtained the highest returns in 1924–25, the lowest in 1926–27 on account of a short crop. In Germany, gross returns were highest in 1925–26, lowest in 1924–25. Australian farmers had a better year in 1926–27 than in 1925–26, because the crop was a third larger while prices were not enough lower to offset the advantage; but the still larger crop, higher prices, and larger yield per acre made 1924–25 the best year of the three. A large crop of good quality rendered 1926–27 a distinctly good year in Argentina, especially by contrast with 1925–26, when the crop was smaller and much wheat sold at a heavy discount for poor quality. In all of these countries, however, conditions naturally varied from region to region; and appropriate allowances for changes in costs and for the seasonal course of farm marketing might alter relationships somewhat.

More specific conclusions may be drawn with respect to the United States and Canada. On the basis of weighted annual average farm prices, which appear in Table 7, and official crop estimates, the value of the United States crop of 1926 was 1,024 million dollars, as compared with 988 million for the crop of 1925, and 1,106 million for the crop of 1924. If the crops of 1925 and 1926 were, as we believe, underestimated, gross values were much the same in the past two years and nearer to the figures for 1924–25 than would otherwise appear. Of the three years, however, 1924–25 was distinctly the most profitable; for comparatively low acreage[1] made for comparatively low total cost of production while prices were comparatively high. Net returns to growers were smaller in 1925–26, in spite of high farm prices, because the crop was much smaller and gross costs were larger. In 1926–27, despite a large crop, lower prices and increased gross costs due to a larger acreage made net returns the smallest of the past three years. But wheat growing was apparently regarded as remunerative by producers. The intentions of farmers, expressed on August 1, 1927, to increase sowings of winter-wheat acreage for the crop of 1928 by 13.7 per cent over the acreage sown for the crop of 1927, may presumably be regarded as a reliable indication of at least relatively good profits in wheat production.

Growers of spring wheat were in a relatively unfavorable position in 1926–27. The prices of No. 1 Dark Northern wheat at Minneapolis were fairly low;[2] and more favorable prices for durum wheat could not have offset the disadvantages of a short crop of hard spring. For this development the excellent quality of hard winter wheat, which permitted extensive substitution, was chiefly responsible. Growers of hard red winter wheat perhaps fared better even than in 1924–25, since the crop of 1926 (especially if allowances are made for official underestimates) was larger. Heavy

TABLE 7.—ANNUAL WEIGHTED AVERAGE WHEAT PRICES IN THE UNITED STATES, 1920–27*

(Dollars per bushel)

Crop year July–June	Farm price	No. 2 Red St. Louis	No. 2 Hard Kansas City	No. 1 Dark Northern Minneapolis	No. 2 Amber Durum Minneapolis
1920–21....	1.83	2.13	1.83	2.01	2.00
1921–22....	1.04	1.27	1.20	1.48	1.19
1922–23....	.98	1.21	1.13	1.26	1.07
1923–24....	.92	1.07	1.05	1.24	1.06
1924–25....	1.28	1.59	1.35	1.58	1.56
1925–26....	1.46	1.69	1.63	1.65	1.44
1926–27....	1.23[a]	1.37[a]	1.35	1.51	1.55
Average					
1909–14....	.89	1.00	.95	.99[b]	.89[c]
1921–26....	1.14	1.37	1.28	1.44	1.26

* Data of U.S. Department of Agriculture.

[a] Preliminary.

[b] No. 1 Northern, which commonly sells from 3 to 5 per cent under No. 1 Dark Northern. The latter was not quoted prior to August 1, 1917.

[c] No. 2 Durum.

[1] See Appendix Table I.

[2] It must be remembered that No. 1 Dark Northern commanded very high premiums in July and August 1926, before the new crop was harvested. For the crop year August–July prices of No. 1 Dark Northern averaged lower than for the crop year July–June.

marketing in July and August 1926 by winter-wheat producers apparently proved about as remunerative as would have been the case with delayed marketing, carrying charges considered.[1]

Canadian farmers apparently enjoyed another profitable year as a result of a large crop and good prices. The average farm price was officially estimated at $1.09, as compared with $1.12 for 1925–26 and $1.22 for 1924–25. With allowances for official underestimates of crop production, farm values were about 340 million dollars in 1924–25, 490 million in 1925–26, and 460 million in 1926–27. The year 1926–27, however, compares somewhat less favorably with 1925–26 because the acreage was some 1.0 million acres larger; but it was unquestionably the most prosperous year since 1920–21, with the exception of 1925–26.

The Influence of the Canadian Pool on Prices[2]

We are of the general opinion[3] that the ways are few through which a wheat growers' co-operative association can increase the returns of its members. It is improbable that the Canadian Pool can handle wheat domestically, and in the export trade, more efficiently and more economically than middlemen. It is difficult to see wherein the increase in scale of operation, beyond a certain point, affords opportunity for economies. It is hardly probable that the Pool can make more money out of mixing than do line elevator companies. It is unlikely that a pool could store and insure the carryover more cheaply than do line elevators. Most of the items in handling grain—cleaning, drying, elevation, storage, interest, and insurance—are the same for everyone and many of them are legally regulated. The Canadian Pool does not hedge receipts, and this may tend to the commercial disadvantage of its members, since the hedging accounts of line elevators are usually profitable. Merely to transfer to growers the net profits of line elevators, would hardly make the organization of a co-operative association worth while. There is much loose talk about securing for growers the profits of grain speculators; but no one knows anything about the profits or losses of speculation. The maintenance of grain exchanges constitutes an item of expense in the grain business. This has a bearing only with the implication that co-operative marketing of wheat might dispense with grain exchanges; but the course of events in Canada has demonstrated that the grain exchange is indispensable to the Pool. Imaginary gains through so-called orderly marketing, in the sense of even distribution over the year, may be disregarded, since the Canadian Pool does not pretend to follow this policy. It is possible for the Pool to look farther afield for export markets than commercial exporters are in the habit of doing, but it is by no means clear how far the results would justify the effort.

The major opportunity for the Pool sensibly to increase the returns of growers (disregarding restriction of acreage) is by elevation of price to purchasers through centralized marketing, indirectly by moderating seasonal fluctuations and directly by semi-monopolistic operations. We incline to the inference that during the past year the Pool has accomplished something in both respects. But this cannot be proved, in part because the Pool does not release the data necessary to undertake the demonstration.

We infer that the Pool policy of selling futures in midsummer for delivery in October–December has some tendency toward stabilizing prices in the summer and autumn to the extent of moderating the seasonal course of prices. Little cash wheat appears on the market during the summer. Apparently, the Pool has sold a considerable volume of futures at this time; the amount is unknown, because both the Pool and the

[1] Official estimates of wheat prices received by producers on the 15th of the month were as follows for 1926–27, in cents per bushel:

July	127.7	Jan.	122.2
Aug.	125.1	Feb.	122.8
Sept.	117.7	Mar.	120.9
Oct.	121.4	Apr.	117.2
Nov.	123.6	May	123.2
Dec.	122.8	June	130.1

In Kansas, Oklahoma, and Texas, however, farm prices were slightly lower in July–September than in subsequent months until April.

[2] We feel that it is necessary to qualify all discussion of the marketing of Canadian wheat by the Pool with the statement that objective appraisal by any outside agency is rendered difficult and hazardous by the secrecy surrounding the affairs of the Pool, the Winnipeg Grain Exchange, and the line elevator companies.

[3] Cf. Wheat Studies, January 1926, II, No. 3.

Canadian Grain Exchange practice secrecy in their affairs. The Pool can afford to sell futures in this manner, as a speculator could not, because through the receipts from members the Pool is certain to have wheat with which to make delivery on the contracts. During October–December the Pool delivers against its contracts, instead of placing the corresponding amount of wheat on the cash market. The net tendency of the double transaction, under favorable circumstances and with skilful management, seems to be a net improvement of the price. In 1926–27 conditions were favorable to the success of this policy, for the Canadian crop improved after July and the trend of world prices was downward. Whether this policy would be successful in the event of a marked deterioration of the crop may be doubted. In one way the transaction is equivalent to hedging receipts; but in most years it is probably better for the Pool to sell futures gradually during the summer, at least to some extent, than to sell them heavily with receipts in the autumn.

The centralized marketing policy of the Pool has been gradually extended to include the presence of representatives in numerous international markets. It is Pool policy never to force the sale of wheat and wherever possible to sell to millers on quality. It is possible to point out instances in which the Pool has sold wheat abroad at cut prices; but over the year, these instances are presumably the exception rather than the rule. Grain importers of Great Britain have become second-rate figures, so far as the Canadian trade is concerned. Not only does the Pool sell direct to millers, but in consequence of direct purchases from the Pool, English millers often find themselves in possession of more grain than they require at the time, and in selling this they become grain dealers, a new function for millers there and one highly distasteful to the established grain trade. When the Pool puts aside the grain importers of Great Britain by selling directly to millers, the traders retaliate by playing against the Canadian wheat the wheats of other countries, particularly those of the Southern Hemisphere. European importers and millers have the impression that the Pool has made Canadian wheat more expensive, and this despite the fact that the Pool has occasionally cut prices in a conspicuous manner. The policy of the Pool of selling direct to European millers has favored the grinding of Canadian wheat in Europe, as against the export of Canadian flour to Europe.

If the Pool has not increased the weighted price in the way suggested, we find little reason to infer that it has done so at all. In terms of figures, the whole subject is still in the dark. The Pool has this year published an audited report for the first time; but it is incomplete and lacking in the pertinent details requisite to critical analysis. It has yearly issued statements of average prices paid for No. 1, basis Fort William, with adjustments for carrying charge, operating costs, elevator services, and reserve. The line elevators do not publish reports of their business. The result is that an appraisal of the effect of Pool marketing on price simmers down to inferences.

During the past three years the average Pool price has declined continuously from 166 to 145 to 142 cents a bushel, basis No. 1 Manitoba Northern at Fort William.[1] This, of course, means nothing unless shown to be out of line with world price of wheat. Nor is the decline inconsistent with the view that the Pool has accomplished something in the upward direction, since without it the decline might have been greater. To compare the declared Pool price with the arithmetic mean of the closing prices of No. 1 Manitoba Northern on the Winnipeg market, or to contrast the straight line of the Pool average price with the curve of closing prices, is not conclusive. If the Pool and the line elevators would both issue reports of actual grain bought and prices paid, the truth would come out.

It has been a misguided propaganda on the part of the Pool to claim that members would receive more for their wheat than non-members would obtain from line elevators. Judged by theory and practice in co-operative marketing, just the opposite would be expected. Everything that the Pool might do to improve the price of wheat would apply to non-member wheat, while the special expenses of the Pool would rest only on members. The non-member stands under the umbrella of the

[1] The Pool is reported to have handled 80 million bushels of the crop of 1924, 212 million of the crop of 1925, and 210 million of the crop of 1926.

Pool when it is raining, and stands out in good weather. It is not to be expected that the management of the Pool would be relatively better than the management of the grain companies that survive Pool competition, since these would be the line elevators with best management and capital structure. Under these circumstances, members of the Canadian Pool ought not to expect as much for their wheat as would be received by non-members, judged in averages. How large a difference should exist is another matter and one that cannot be gone into for lack of data.

We have felt tempted to make a comparison of the Pool price with a weighted price. If line elevators made no purchases in the country, then Winnipeg receipts would correspond to the sales of the day. This of course is not true; but it does not seem to do violence to a reasonable interpretation of affairs to regard the receipts of the day in Winnipeg as corresponding to wheat sold at the price of the day in Winnipeg. The Pool has announced as an average price of No. 1, basis Fort William, for the last crop, 142 cents. We have taken the average closing price of No. 1 Manitoba Northern for each week and multiplied it by the weekly receipts of No. 1 at Winnipeg, and with these figures have secured a weighted price for the year September 1926—August 1927. This price was 143.3 cents, which is more appropriately comparable with the Pool price, than is the arithmetic mean of daily closing prices, 147 cents.[1] However, the fact that Pool members must wait for a portion of their payment while non-members sell for cash, increases the margin between the two returns. In view of our opinion that the Pool members cannot expect as high a price as non-members, with the Pool in operation, even if the returns to both are increased, we feel that the Pool cannot be commended or condemned, in its financial aspects, on the basis of the above figures.

It would be premature to judge the Canadian Pool merely by three years of performance. Pool marketing is the expression of a world-wide trend toward socialization of business, including both horizontal and vertical integration, with elimination of intermediary agencies. For two years the Pool was aided by favorable circumstances. During the past year the going has not been so easy, and the Pool was fortunate in being able to dispose of its large carryover at good prices, before the advent of a large new crop and lower prices. International dissensions are in the offing; many members do not approve of the trading in futures by the management of the Pool, they do not wish the Pool to play the selling game just as the middlemen always played it, they do not like the contract of the Pool with the line elevators. This year much will depend on the outcome of the Argentine crop. If this crop is large and the wheat dry and of relatively high protein, it will sell at a relative premium in Europe for mixing with the wet, soft wheat of the present European crop, the Canadian wheat being relatively high in moisture and low in protein. If the Argentine wheat is no better than the Canadian wheat, with a short crop in Australia, the sales of the Canadian Pool will be greatly facilitated.

VI. MILLING AND CONSUMPTION

An adequate review of flour milling and wheat consumption throughout the world is not feasible in view of the fragmentary and tentative nature of basic statistical data. With respect to consumption, little is known of changes in wheat stocks or of the quantities of wheat fed to animals or wasted. For many countries mill grindings —fundamental data because volume of grinding is necessary for prosperity in the milling industry—are either not reported or are reported only after the lapse of many months. Only a broad impression of operations in the milling industry can be obtained by week-by-week perusal of milling journals. Volume of flour exports and imports provides the best available (but still an inadequate) guide to the milling situation. Our account is necessarily provisional and incomplete; but some items of interest and significance appear.

[1] This figure may be compared with the officially estimated farm price of 109 cents, published in January 1927.

International Trade in Flour

The milling industry is overextended in most countries; and the difficulties of achieving prosperity are increased by the erection of tariff barriers resulting in a declining trend in international trade in flour. Gross exports of flour were but 38.3 million barrels in 1926–27—almost the same as in 1925–26, but much smaller than in 1923–24 or 1924–25. Total exports of flour, according to incomplete but fairly comprehensive data assembled by the International Institute of Agriculture, in million barrels, were as follows for the past six crop years:[1]

1921–22	34.3	1924–25	45.0
1922–23	37.3	1925–26	38.2
1923–24	48.1	1926–27	38.3

Comparisons are difficult because abnormal circumstances have affected the figures. One may regard the flour shipments of 1923–24 as abnormally high because of abnormally low prices, and similarly with 1924–25 because European wheat crops were so small. On the other hand, shipments were abnormally low in 1925–26 because European wheat supplies were so large. But the figure for 1926–27 is impressively low in view of the facts that trade in wheat and flour combined was the largest in history, and that normal growth in proportion of flour trade would imply for 1926–27 considerably higher figures than appeared. The world's bread is apparently tending to move in international trade as wheat rather than as flour; exporting countries are losing their flour markets, and importing countries are tending toward self-sufficiency in milling.

Of major significance for the milling industry, however, were the events in particular countries during 1926–27. Canadian exports of flour were the smallest in five years, despite an abundant crop. Smaller exports from the United States during the past six years have not been recorded except in the year of short crop, 1925–26. Hungary and Jugo-Slavia exported comparatively little despite good crops; and French, Belgian, and Italian exports combined were the smallest in six years. Among the larger importing countries, Germany, Czecho-Slovakia, and Poland took exceptionally small quantities of flour; and only the United Kingdom, Netherlands, and Denmark imported notably large and increased quantities.

Milling in the United States

The past year was the best season enjoyed by American millers since the war. This was due to a fortuitous combination of favorable factors. The crop was generous, for the most part was harvested expeditiously and in good condition,[2] and was well proportioned for the manufacture of bread flour. (The crop of durum, however, was short; and the prices of semolina and alimentary pastes were out of line.) Millers were early in position to make large purchases of unusually good wheat at relatively favorable prices. The total grinding of the year, according to our best estimate, was 555 million bushels, an excess of 12 million bushels over the grinding of the previous year; but flour production was proportionately large—119.4 as against 115.4 million barrels.[3] An unusual proportion of the annual flour production was sold and ground during the first three months of the year; in the last quarter millers complained of low sales, disregarding the extraordinary sales made during the first quarter.

All regions did not share equally in the large outturn. The Buffalo mills had the largest relative gain. The mills of the southwestern region enjoyed a remarkable year; flour mills in Kansas City (Missouri), Kansas, Nebraska, and Oklahoma turned out nearly 31 million barrels of flour, an outstanding record. The mills of the southeastern and Pacific soft-wheat region enjoyed a high level of outturn. In the northwestern spring-wheat region the outturn was apparently up to the level of 1925–26, despite a smaller number of mills operating and a small crop of spring wheat.[4]

[1] Chiefly as shown in *International Yearbooks of Agricultural Statistics*. Includes exports by importing countries. Figures for 1926–27 especially subject to revision.

[2] It is interesting to speculate whether the combine method of harvesting may modify the seasonal curve of milling.

[3] Raised from Census Bureau's figures. See Appendix Table XXVII.

[4] Production of large mills has been steadily increasing, and small mills are disappearing. See Robert T. Beatty, *Northwestern Miller*, November 16, 1927, p. 625.

The operations of the year were profitable to milling companies beyond the measure indicated by a bare comparison of wheat and flour prices. The particular circumstances supporting profits were high yield of flour, low premiums on protein, and high prices for millfeed. The average barrel of flour required only 4.57 bushels of wheat, whereas in the previous year it took 4.64 bushels;[1] the flour outturn of the year required some 7 million bushels less wheat than would have been required with the quality of the crop of the previous year. Premiums on protein were relatively low, partly on account of the even quality in the different regions and the high yield of flour, but particularly on account of the large proportion of high grade wheat in the hard winter-wheat crop. Prices of millfeed were out of line upward practically throughout the entire year, also out of line with the prices of coarse grains. Of course a high yield of flour meant a low yield of millfeed, but it was strong demand and not short supply that brought the high price. These circumstances made it possible for the huge advance sales of flour on contract made during the first three months of the crop year to be carried through with unusual profits to millers as a whole. Some companies naturally profited more than others; some indeed profited poorly. Even under favorable circumstances, sound capital structure and efficient management had their influence on profits.

Whether or not flour exports were a factor in the year's prosperity is a difficult question. Exports in 1926–27 were 13.4 million barrels—a figure lower than in any year since the war, 1925–26 excepted; and 1925–26 was a distinctly unfavorable year on account of the small crop and relatively high prices of wheat. On the whole, American flour exports are tending to decline; but this may have no great bearing on the prosperity of the American milling industry. We incline to the view that much of the flour sold in Europe in 1926–27 meant small or negligible profits to American millers; the comparative cheapness of American flour in Europe supports our inference, though sales made early in the year may have proved remunerative. In any event it seems probable that domestic, not export, business was the significant factor for the fortunate position of American milling in 1926–27.

Our flour exports to Europe increased over those of 1925–26 in striking contrast with the flour exports of Canada, which declined. Similarly, our flour exports to China increased, while those of Canada declined, against which must be set a failure in our flour trade with Japan.[2]

The year was characterized by a noteworthy increase in coastwise shipments of Pacific flour through the Panama Canal to the Atlantic seaboard.

Milling in Canada

The position of the Canadian milling industry for the year 1926–27 is difficult of definition. Though the volume of operations was smaller than in 1925–26, there is evidence in published accounts of milling concerns that net returns per barrel may have been larger. But the Canadian industry did not enjoy so profitable a year as the American. This in itself might have been the result of the difference in quality of wheat in the two countries; but the Canadian mills hold the opinion that it was due largely to differences in the marketing of wheat.

The flour output of the year was 17.8 million barrels, as against 19.0 million the previous year. Since change in population has been slight, with nothing to indicate any shift in per capita consumption, the explanation is to be sought in export trade, to which more than half the Canadian flour is necessarily consigned. The percentage of the total flour production exported was the smallest since the war. The total export declined from 10.9 million barrels in 1925–26 to 9.2 million in 1926–27—the lowest figure in five years. Two-thirds of the decline represented a falling off in European business; even exports to the United Kingdom were not maintained. In short, the Canadian milling industry during the year lost foreign business that had been previously held by them and to which they believed they were entitled. Canadian flour exports to Europe have declined progressively dur-

[1] Census Bureau figures; if smaller mills than those reporting production are allowed for, these milling ratios must be raised by around 1.5 per cent.

[2] See Appendix Table XIX.

ing the past four seasons and the situation is naturally a source of apprehension to the industry involved.

Exporting flour is a principal business of the Canadian industry, while it is a side business of the American industry. Canadian millers cannot afford to dump export flour as American millers often feel compelled to do.[1] Despite the poor quality of the crop it is difficult to believe that Canadian flour exports fell off for reasons of quality, contrasted with American export flours and European blended flours.

Four specific factors have been advanced in explanation of the decline of Canadian exports: (1) relatively low ocean freight rates accorded to wheat; (2) higher tariff duties levied on flour than on wheat in European countries; (3) competition of flour ground from Canadian wheat in American mills; and (4) the selling policies of the Canadian Wheat Pool.

American as well as Canadian millers make complaint against ocean freight rates, giving preference to wheat over flour. The effects of relatively higher freight rates on flour than on wheat, in the absence of week-by-week data, are hard to evaluate; but this factor was perhaps of some significance. It is not easy to understand why European tariffs should hit Canadian flour harder than the flours of other exporting countries; and tariffs cannot explain the decline in Canadian flour exports to Great Britain. So far as American mills grinding Canadian wheat in bond for reexport of flour are concerned, these occupy in relation to Canadian mills the same position as that held by mills grinding Canadian wheat in free-trade countries; whether American and British mills grinding Canadian wheat for European sale injure Canadian mills more or less is a broad question of expense, financial structure, and transportation costs.

In the fourth point we deal with a subject of critical interest in Canada. One object of the Pool is to eliminate middlemen; and it thus seeks to deal directly with millers in Canada, in the United States, and overseas. This in itself would not injure Canadian milling, if the mills in all countries paid equivalent prices for wheat. Reasons might be advanced in favor of Canadian mills receiving wheat at something less than equivalent prices, in order to secure for Canada the advantages of value added by manufacture. As the Pool policy works out, however, it seems that Canadian millers pay more than equivalent prices for wheat—i.e., Canadian flour is relatively more expensive abroad than flour ground abroad from Canadian wheat. That Canadian mills might work on two price levels—a higher one for domestic flour and a lower one for export flour—is not considered practical. In January 1926 it was reported that an understanding had been reached between Canadian millers and the Pool whereby millers would be advised of quotations to foreign mills and would receive equivalent prices.[2] Apparently nothing came of this understanding, since at the May 1927 meeting of the Canadian National Millers' Association, resolutions were adopted appealing to the Pool to grant to Canadian mills fully equivalent prices for wheat, in order at least not to discourage export of Canadian flour.

The Pool has not been in position, or has not taken occasion, to refute the statement that Canadian wheat is relatively cheaper to European mills than to Canadian mills. Is the situation accidental and temporary, or is it inherently an effect of Pool merchandising policy? To some extent in Canada, the milling industry has been identified with the grain trade; many men are both millers and grain traders; and growers feel against the milling trade something of the same resentment they hold against the grain trade. There are several possible reasons, operative in Europe, why European millers might expect to receive lower equivalent prices than Canadian millers. Pool sales to European millers are private transactions; having large amounts of wheat to dispose of, the Pool might accept a secret bid from a large European miller at a lower price than the Pool would wish to announce to all mills, and of course at a lower price than it would consider in a sale to a grain trader.

[1] Yet the chairman of the Spillers company has made the statement that the bulk of flour imports from all sources into Great Britain were made at no profit and a considerable proportion dumped; corresponding statements have been made by continental millers. It is difficult to conceive that appreciable quantities of Canadian flour could have been sold at a loss.

[2] See WHEAT STUDIES, III, 120.

This would also be a lower price than could be offered on non-Pool wheat by an independent merchant. Of course, European millers play the Pool against the grain traders; but European millers and grain traders are convinced that mills frequently buy wheat from the Pool at prices for which North American exporters and European importers could not afford to sell. Secondly, the entry of British millers into the grain trade to dispose of parcels of wheat in their hands in excess of current requirements, has meant lower prices because it was dumping. Canadian wheat imported for blending cannot usually pay the premium for protein carried by straight Canadian flour, which tends to depress prices of Canadian wheat to European millers. Lastly, the Pool policy of stationing representatives in European countries has necessarily led to expansion of wheat shipments on consignment. Such wheat, unless promptly sold, piles up carrying charges in European ports; and since the consignments cannot be accurately proportioned to sales, but will usually be in excess of them, the situation resolves itself into a position of trading advantage for the purchasing European mills. It is an old experience in the wheat export trade that shipments on consignment lead to price-cutting to avoid carrying charges.

During the past season the Canadian mills have supposedly adhered to an arrangement for quoting common prices for export, in order to avoid price-cutting; this may have tended to favor higher flour prices in Canada. Flour ground in Canada arrives in the United Kingdom in better condition than flour freshly ground there from Canadian wheat, because it is mature; but this advantage has apparently been lost in the shuffle.

It is not to be believed that the Pool desires to diminish Canadian flour exports by favoring European millers; it could not justify this course from any standpoint of domestic or international policy. Either the situation is the natural result of the various marketing factors or it is a temporary dilemma because a difficult problem has not yet found a solution. Clearly the future of the Canadian milling industry is tied up with the merchandising policy of the Pool; and from the standpoint of Dominion policy the marketing problem of the growers cannot be regarded as solved so long as the milling industry rests under the shadow of discrimination.

The decline in Canadian flour exports in 1926–27 thus may perhaps have been due in some part to the disadvantage at which Canadian millers were put by having to pay relatively high prices for Canadian wheat. But it must be recalled that relatively high prices for Canadian wheat on international markets in the latter half of the year, in some part the result of Pool policy, must have tended to make Canadian flour wherever milled, if milled at a profit, relatively expensive. The competition of American flour in the first half of the year, and of Australian and Argentine in the second, presumably combined with the Pool's price-raising tactics to render difficult the situation of Canadian millers.

Milling in Europe

The milling industry of Europe, like that of most other parts of the world, is overextended. The new frontiers of Europe have introduced abnormalities in relation both to sources of wheat and to flow of flour. Therefore milling journals in Europe are filled with jeremiads. The tenor of the complaints varies from year to year; sometimes it is price, sometimes volume of imports, sometimes artificial restrictions and discriminations, sometimes unfair methods of merchandising. The picture is confused. The continent cannot, of course, be regarded as a unit.

Jugo-Slavia and Hungary, surplus wheat-producing countries, are naturally net flour exporters; but they have been losing ground. France, Italy, and Belgium, wheat-deficiency countries, which have been surprisingly prominent as flour exporters during recent years, have also been fading out of the picture. They are not naturally net flour exporters: it is only under unusual circumstances in milling that a heavy wheat importer becomes a net flour exporter.

Hungary possesses an enormous equipment of high-grade flour mills built for the old Austro-Hungarian Empire and contiguous regions. These mills cannot be kept occupied on Hungarian wheat, but must draw their wheat from the entire Danubian region. In order to promote their own milling

industries, the surrounding countries have placed obstacles in the flow of wheat toward Hungary, which have even led to imports of wheat from Buenos Aires to Budapest. Not only are the surplus wheat-producing neighbors of Hungary trying to make their wheat expensive for Hungarian mills, but the flour-importing regions that constituted her previous flour markets are trying to keep out Hungarian flour in order to promote their own milling. In effect, Hungary faces wheat-export duties on the one hand and flour-import duties on the other. It is doubtful if the Hungarian mills last season operated to 25 per cent capacity. Even for domestic wheat, the trend is in the direction of exports of wheat rather than of exports of flour. Although Hungarian net exports of wheat in 1926–27 were the largest since the war, her net exports of flour were smaller than in any year except 1922–23, when the crop was short. The continued difficulties in navigation of the Danube and abnormally high freight rates on Hungarian railways have contributed to the difficulties of the mills. There has been misguided speculation and financial mismanagement in the operations of Hungarian mills, made worse by excessive rates of interest on bank loans. Limited to native wheat supplies, of which the quality has deteriorated since the war, Hungarian flour no longer holds the high rank to which it was accustomed, and harder flours from other countries are now widely preferred. Hungary is now negotiating commercial treaties with her neighbors, through which she hopes to secure outlet for flour, particularly in Austria, Czecho-Slovakia, and Poland; but it seems doubtful whether substantial relief is in sight. Unless the political atmosphere of Central Europe changes quickly and profoundly, the Hungarian milling industry faces extensive liquidation.

Conditions of the milling industry in Jugo-Slavia continue bad. The lost prosperity of Hungarian mills was not conferred upon Jugo-Slavian mills, the milling capacity of the new country exceeding requirements of the domestic market and the customary export markets. Curiously enough, Jugo-Slavia has felt compelled to protect the native mills from Italy. High import duties in Czecho-Slovakia and higher transportation rates to Greece have reduced exports in those directions. So long as an export tax on wheat existed, this favored the mills; but when agrarian agitation resulted in the abolition of this export duty on wheat, the export of wheat was favored at the expense of flour, of which the export has been declining. Like Hungary, Jugo-Slavia in 1926–27 had smaller net exports of flour than in any other year since the war except in 1922–23.

Roumania also has an overextended milling industry. Impediments to the navigation of the Danube, inefficient handling at ports, and high railway charges have made it difficult to deliver Roumanian flour in central and western Europe in competition with flour from overseas, particularly in countries with import duties and high specifications on quality. Nevertheless Roumanian exports of flour have been increasing for the past six years, and were larger in 1926–27 than in any recent year except 1923–24. Large crops of cheap wheat have apparently facilitated flour sales; Roumanian flour, like Roumanian wheat, has been available at very low prices. It is not apparent, however, that the Roumanian milling industry has made substantial gains.

Austria, Czecho-Slovakia, and Poland have continued their efforts to break the pre-war dependence of those regions on the Hungarian flour mills. Each country is trying to protect its wheat and rye growers, as well as its wheat and rye millers, which in the nature of things is not easy. During the year, the Austrian duties were changed slightly to the advantage of flour, though the import duties were increased on both flour and wheat. The Czech duty on wheat was high, but still higher on flour, and imports have been greatly reduced. Until the spring of 1927 the drawback on export of German flour favored German flour in Poland against Hungarian. Poland has attempted to facilitate the export of certain grades of wheat and rye and the import of others, and has had an import duty on flour. All circumstances considered, the year has been relatively favorable to the mills in Austria, Czecho-Slovakia, and Poland, though least so in Austria. With expansion, new troubles will develop.

Flour milling and bread baking in Italy are under minute regulations designed to promote the use of domestic, and to dis-

courage the use of imported wheat. During the past crop year a standard extraction was fixed at 85 per cent, with differentials for varying wheats. Imports of flour were restricted by tariff duty and by provision against the importation of low-extraction flour. Whether the import duties on wheat and flour have favored wheat or flour is a matter under dispute, though the large coastal mills have appeared to suffer more than interior mills, partly because small mills have partially evaded the stringent milling regulations. The policy of the government is against maize and in favor of wheat. Furthermore, there is evidence of widespread preference for wheat, both in the form of bread and alimentary pastes, and the stabilization of industry in the country has aided in this direction.

The milling year 1926–27 in Great Britain was enlivened by more than usually active controversy between importers of flour and millers of flour from imported wheats. Great Britain has a heavily overextended milling industry. Though the figures are not yet adjusted for re-exports, it would seem that the United States shipped more wheat and flour to Great Britain than did Canada. Apparently, home-ground flour suffered more from American than from Canadian competition, and in general British millers during the year resented what they regarded as a dumping of flour into Great Britain. Both gross and net imports of flour were the largest in four years, a circumstance not readily explicable unless imported flours were offered at unusually low relative prices. During the year a governmental board attempted, with little success, to regulate the prices of bread and flour with relation to each other. What with the disorganization of the importing trade by the Canadian Pool and the difficulties of the millers and bakers under governmental regulation, the occupations revolving about wheat would seem to have had an unsatisfactory season during 1926–27. The situation in Irish mills became so difficult during the year as to arouse a demand for imposition of a tariff duty on wheat — directed against Great Britain rather than against Canada and the United States.

During the year the Belgian government practiced both import and export regulation, established a legal extraction of 80 per cent, and prescribed the admixture of 15 per cent of rye, restrictions that were withdrawn later in the year. The Belgian mills have continued to lose the re-export trade in flour that was so profitable to the mills a couple of years ago.

In France the government enforced during the year a high milling extraction and made the admixture of 10 per cent of rye or other substitutes compulsory. In response to agitation of consumers, turnover taxes were levied on the sale of flour and maximum prices were fixed in different parts of the country. Under the existing tariff, wheat is apparently favored at the expense of flour, though special reimbursements to millers were made applicable to the grinding of imported wheat for domestic consumption of flour. Millers chafed under the multiplicity of regulations, and it is doubtful, in view of an apparent reduction in flour consumption, if the milling industry enjoyed even a fairly prosperous year. The sharp decline in exports of flour has further represented some loss to the French mills.

At the beginning of the crop year, German millers secured an increase in the duty on flour, and the duty was further extended in the spring. These higher duties, with continuation of the export certificate system, have operated in favor of the native milling industry, especially against the mills of Holland. Under these circumstances it is not surprising that imports of flour fell to practically a third of the amount of the previous year. The trend of the consumer's taste in Germany is in favor of wheat and from rye, and since there is less country milling of wheat than of rye, this has improved the position of the larger mills. At the same time German mills complain of the narrow margin of returns.

The milling journals in Denmark, Holland, and Switzerland picture those countries as swamped with import flour during the year, and official reports tend to confirm the complaints, notably in Holland. Mills in Holland suffered not only from strong competition of American flour, but also from the loss of the German market. In all of these countries, wheat is gaining at the expense of rye, and the milling industries are both overextended and dislocated. At the

close of the year the government of Norway abandoned the monopoly of breadstuffs that had existed for over a decade; import duties on wheat and flour were continued, the revenues of which go as subsidies to growers of bread grains; the largest mill in the country has been and continues to be operated by the government; and a uniform price of flour is also to be continued, with differentials and freight compensations.

The milling industry of Greece has not been large enough to cover domestic requirements of flour, but is attempting to emulate the milling expansion of other countries. In consequence of increase in population through return of refugees, flour imports rose notably several years ago. These import flours were largely clears, with a relatively high acid and ash content. Using this as a pretext, governmental restrictions were set up on the basis of alleged inferiority, which have had some effect in restraining imports. During the course of the year an increased duty was applied to flour, directly and also indirectly through change in the rate of conversion of metallic to paper drachmas, supplemented by excise taxes. The final result approached an embargo on import of flour, resulting in a situation now in course of diplomatic discussion between the governments concerned.

Spain also has an overextended milling industry which during the past year has been operated largely under governmental regulation, especially as regards imports and exports. With favorable crops in 1925 and 1926 the impediments to exportation were minimized, and Spain exported more flour than in preceding years. During the year Spain has witnessed a continuous struggle between millers and bakers over the price of flour. In Portugal the government regulation of milling has remained quite as elaborate as during the war; even the quantities of wheat to be imported in 1926–27 were authorized specifically by governmental decree.

There is little to report on milling in Russia. The industry has been nationalized, if not rationalized; it is overextended and inefficiently operated. On account of high costs of operation and merchandising, Russian flours are priced out of line in the export markets. Turkey, Esthonia, Latvia, and Finland have import duties that operate more effectively against Russian flours than against flours from overseas.

Milling in the Orient

The milling industry of eastern Asia is literally a hodgepodge. China has a large but unmeasured crop of wheat, possibly as much as 400 million bushels, all produced in the interior. In the absence of civil war or other domestic disturbance, Chinese wheat flows coastward in quantities varying with the size of crops. In the event of civil war, disturbances in transportation, abnormalities in currencies, or short crops of wheat in the central and northern provinces, the flow of native wheat to the coast is curtailed. Coastal provinces consume flour milled from native wheat, flour milled from imported wheat in Chinese mills, flour milled from imported wheat in Japanese mills, and flour imported from Canada, the United States, and Australia. There are no duties on wheat and flour imports for the country as a whole; in times of disturbances there are often local exactions. With good crops of all cereals, China is occasionally a net exporter of flour in the absence of civil war; under less favorable circumstances of crops, the country is a net importer. Occasionally there may be a glut of wheat in the interior, with active imports of wheat and flour from overseas into the coastal cities. In times of peace, if the crop of native wheat is large enough to permit of a considerable shipment to coastal cities, this wheat is usually cheaper at the mill door than are foreign wheats; and under these circumstances the native mills are apt to be active. When native wheats are lacking the native mills find it difficult to import wheat and compete with imported flour. Despite this, the milling industry of China is overextended, as is that of Japan.

During 1926–27 mills in the coastal regions were hampered not only by the mediocre crop in the interior and by disturbances in transportation of such native supplies as were available, but also (on account of the imperative need of flour for the armies) by conditions favoring the importation of flour rather than wheat from overseas. Nevertheless there were times during the year when native flour has been below the import prices of Canadian, Ameri-

can, and Australian flours, obviously the result of depressed interior domestic purchasing power. There has been hoarding of flour in some cities, with strikes against foreign flour in other cities. The total picture of Chinese milling is dark; but how dark may not be judged by crop reports, grindings, imports and exports, or prices.

The consumption of wheat is expanding in Japan, but not as rapidly as the mills have expanded. When Chinese demand for import flour is active, the Japanese mills have a good season; when the Chinese wheat crop is good, the Japanese flour trade with China languishes. With the consent of the government, the Japanese mills have been working under an arrangement in respect to the domestic trade, whereby a regular program of curtailment of production has been ostensibly followed, varying according to the size of the mill and amounting to as much as 50 per cent for the larger mills (two milling companies control three-fourths of the flour production of the country). The agreement does not apply to the export trade, which has faced peculiar difficulties on account of the civil war in China. Despite the short crop in China, large exports of Japanese mills were impossible; and Japan was a small net importer on the year. All in all, the Japanese milling industry is in a precarious position, which may have been somewhat ameliorated, but has not been cured, by the trade agreement under which the mills are operating.

Consumption in Leading Exporting Countries

Wheat produced in a given year disappears either as human food, as feed and waste, as seed, or as increases in stocks of wheat and flour. For the major exporting countries, but for no others, it is possible to reach acceptable estimates of wheat used as human food and as seed. Changes in stocks and feed use of wheat provide greater difficulties.

For the United States, we estimate consumption of wheat for human food in 1926–27 at 492 million bushels, the same figure as in 1925–26.[1] A high yield of flour per bushel of wheat, due to the high quality of the winter-wheat crop, counterbalanced an increase in population. Seed requirements of 85 million bushels were slightly larger than in 1925–26 on account of the larger acreage sown, but not so large as in 1922–23 or 1924–25. Feed use of wheat was doubtless not large in view of the high quality of the crop, but a figure so low as the 20 million bushel figure indicated by our calculations of disposition seems incredible and reflects on the accuracy of the crop estimate.[2]

In Canada the notable feature of consumption in 1926–27 was the large amount of grain lost in cleaning and otherwise unmerchantable, officially estimated at 31.4 million bushels as against 17.5 million in 1925–26 and 22 million in 1924–25. The figure was no higher even in 1923–24, when the crop was larger and wheat prices were far lower. This was due to the relatively poor quality of the 1926 crop. Consumption of wheat for human food, which we estimate at 44 million bushels, was also high on account of a high milling ratio.[3] Seed use of wheat was slightly smaller than in 1925–26 on account of a smaller acreage seeded in the spring of 1927. Wheat fed on farms must have been larger in amount in 1926–27 than in the two preceding years on account of the larger proportion of damp grain. Accepting official estimates for the items of disposition so far as available, we conclude that the crop of 1926 was underestimated by about 20 million bushels.[4]

Of consumption in Australia little can be said. Wheat used for feed[5] is at best a small

[1] Our estimates of wheat consumption for human food are based upon adjusted data for flour production, adjusted milling ratios, and estimates of population. For recent years we assume a constant figure for per capita production of flour of .9 barrel. This method of estimation will be explained in detail in a forthcoming issue of Wheat Studies.

[2] See above, p. 19.

[3] Official estimates of wheat milled for consumption in 1926–27 have not yet appeared. The milling ratio of 1926–27, 4.54 bushels per barrel, compares unfavorably with the ratios for 1923–26 (1923–24—4.46; 1924–25—4.49; 1925–26—4.48) and leads us, on the assumption of constant flour consumption per capita, to the figure of 44 million bushels milled for consumption in 1926–27.

[4] See Appendix Table XXXII. Official calculations of disposition, which contain a preliminary figure for human consumption of only 39.4 million bushels and allow nothing for wheat fed on farms, indicate an underestimate of only 5.6 million bushels. See *Handbook for the Use of Crop Correspondents*, 1927, p. 30.

[5] The *Australian Yearbook, 1926*, p. 640, estimates the use of wheat for poultry and livestock feed and for seed for green forage as .5 to 1 bushel per capita per annum. For recent years this implies annual disappearance of only 3 to 6 million bushels.

item. There is no evidence of changing per capita consumption, seed requirements change only about a million bushels from year to year. Variations in quality from year to year are slight in Australia, where neither frost, rust, nor excessive rain is common; hence large variations in quantities of wheat milled or fed and wasted do not ordinarily occur.

The poor quality of the crop of 1925 in Argentina gave rise to exceptionally heavy disappearance of wheat both for flour milling and for feed and waste not only in 1925–26, but also in 1926–27; for the crop of 1925 was being utilized throughout the calendar year 1926 and even into 1927. The natural crop year in Argentina is not August–July, but January–December, and this fact combined with the publication of milling statistics for the calendar year makes difficult the adjustment of consumption figures to the European crop year. On the basis of such adjustments, however, we estimate human consumption of wheat at 55 million bushels in 1926–27 as compared with 54 million in 1925–26 — a difference smaller than would be expected in view of increased population and increasing per capita consumption,[1] but larger than would be indicated if wheat of good milling quality had not been available from January to July 1927.[2] For seed requirements and feed and waste our estimates for the past two years are in some measure arbitrary; but higher figures than those of 1922–25 are reasonable not only because acreage has increased, but also because of the exceptionally poor quality of the wheat available throughout the calendar year 1926.

Consumption in Europe Ex-Russia

For European countries, information respecting consumption is limited in most instances to data on apparent domestic utilization or available supplies—crops plus net imports, or minus net exports. These data are in themselves subject to a considerable margin of error on account of inevitable inaccuracies in crop estimates; and they are misleading indexes of consumption—whether for food, feed and waste, or seed—because corrections for changes in stocks cannot be made on the basis of available information.

For the past four years, available supplies of wheat in Europe ex-Russia as a whole were as follows, in million bushels, on the basis of available official data:

Year	Crops	Net imports[a]	Supplies
1923–24	1,249	543	1,792
1924–25	1,051	623	1,674
1925–26	1,401	464	1,865
1926–27	1,208	616	1,824

[a] The sum of net imports by importing countries less the sum of net exports by exporting countries. Contains some estimates.

According to these data, uncorrected for errors in crop estimates or for changes in stocks, wheat disappearance in Europe as a whole in 1926–27 was only about 40 million bushels smaller than in 1925–26, despite a domestic crop nearly 200 million bushels smaller. On the other hand, disappearance in 1926–27 appears larger than in 1923–24 by only 30 million bushels, despite a crop 40 million bushels smaller, and prices much higher than in the earlier year. But the available supply figure for 1926–27 is certainly too low if only because both the crop and the imports of France are understated;[3] with allowance for these understatements, European disappearance was apparently about as high in 1926–27 as in 1925–26.

Yet non-statistical evidence respecting changes in stocks alters the picture still further. Stocks increased largely in 1926–27 and in 1923–24, decreased largely in 1924–25, and increased a little in 1925–26. It is impossible to measure these increases or decreases. On the crude assumption that stocks increased 30 million bushels in 1926–27 and 1923–24, decreased by the same amount in 1924–25, and increased 10 million bushels in 1925–26, and that the imports and crop of France in 1926–27 are understated by at least 30 million bushels, apparent domestic utilization of wheat in Europe ex-Russia as a whole would be as follows in million bushels:

1923–24 1,762	1925–26 1,855
1924–25 1,704	1926–27 1,824

[1] For evidence that per capita consumption of flour in Argentina is increasing, see *Northwestern Miller*, September 14, 1927, p. 1019.

[2] Milling ratios in tons of wheat per ton of flour, were as follows for calendar years in Argentina:

1922 ..... 1.4337	1925 ..... 1.4147
1923 ..... 1.4339	1926 ..... 1.4613
1924 ..... 1.4140	

[3] On understatement of imports, see above, p. 13; of crop, see below, p. 44.

With these admittedly crude corrections, it still appears that 1924–25 was a year of reduced consumption, as is reasonable in view of the very short crop and high prices in that year. That European consumption was much larger in 1926–27 than in 1923–24, despite much lower prices in the earlier year, is reasonable in view of growth of population, increased seed requirements, and economic recovery; and larger consumption in 1925–26 than in 1923–24 is reasonable not only for these reasons, but also in view of the exceptionally large European crops of 1925. Both 1926–27 and 1925–26 were clearly years of relatively large consumption. But whether or not European wheat consumption was in fact larger in 1925–26 than in 1926–27, it is impossible to say. Accurate data on crop production and changes in stocks might either reverse or intensify the difference shown by the figures above.

The situation differs, however, from country to country within Europe. Table 8 shows

TABLE 8.—APPARENT DOMESTIC UTILIZATION OF WHEAT BY CERTAIN EUROPEAN COUNTRIES, AUGUST–JULY, 1921–27*

(Million bushels)

Country	1921-26 average	1922–23	1923–24	1924–25	1925–26	1926–27
British Isles	280	276	298	282	264	289
Italy	287	277	294	259	309	307
Germany	154	109	137	170	176	187
France	328	289	329	340	341	294
Holland	48	45	52	50	53	55
Roumania	84	90	93	67	95	99[a]

* See Appendix Table XXXI for details and qualifying notes.

[a] Net exports partially estimated.

available supplies of wheat for the past five years in certain European countries where significant changes have occurred. In Great Britain, consumption was presumably relatively low in 1926–27, because a considerable increase in stocks was effected in the course of the year. It is unlikely that the quantity of wheat actually consumed equaled the average for 1921–26,[1] though it was larger than in 1925–26. Unemployment resulting from the coal strike may have reduced consumption during August–November, as had been the case during May–July of the crop year 1925–26, and per capita flour consumption is apparently declining.[2] But despite an increase in stocks, which renders the 1926–27 figure of available supplies too high as an index of consumption, the lower prices of 1926–27, coupled with a sharp revival in business activity after the renewal of coal mining, prevented consumption from falling to the notably low level of 1925–26.

In Italy available supplies in 1926–27, some 307 million bushels, were about the same as in 1925–26, and again well above average. There was, however, a considerable increase in stocks; and on the whole consumption of wheat was probably smaller than in 1925–26, though presumably slightly above average. Exceedingly high prices and measures requiring millers to produce a flour of high extraction acted to reduce gross consumption in both years; but increases in population, per capita consumption, and purchasing power have apparently more than counterbalanced these influences. Milling regulations, however, were more stringent in 1926–27 than in 1925–26, and the domestic crop was smaller.

Available wheat supplies in Germany have increased consistently in the course of the past five years. Since there was apparently no notable increase in stocks during 1926–27, consumption of wheat in Germany appears to have been higher in 1926–27 than ever before, despite the high prices. A part of the increase over 1925–26 was due to more extensive use of poor quality wheat for feed; but improving economic conditions have apparently favored increasing use of white bread. In Poland also consumption in 1926–27 was apparently the largest in five years, especially since stocks were reduced in the course of the year. The increase occurred despite high prices, and may reasonably be ascribed to a growing preference for wheat bread made effective by economic recovery. The high figure for available wheat supplies in Roumania in 1926–27, some 99 million bushels as compared with a 1921–26 average of 84 million, reflects an increase in stocks and heavy utilization of poor quality wheat for feed.

[1] In so far as crop estimates are accurate, the averages of annual figures for available supplies may be regarded as reliable indicators of consumption, for the disturbing effect of changes in stocks is largely eliminated by averaging.

[2] See WHEAT STUDIES, III, 104.

Available supplies in France, according to the data of Table 8, were only 294 million bushels in 1926–27 as compared with the 1921–26 average consumption of 328 million bushels. The 1926–27 figure is clearly too low because imports for the year are understated; but an allowance for this understatement would be more than counterbalanced by an allowance for increased carryover. Certain factors made for relatively low consumption in 1926–27. Wheat prices were the highest in four years; millers were obliged not only to mix 10 per cent of other cereals with wheat, but also to obtain a high extraction; and the tariff was effective for most of the year. Nevertheless we find it difficult to believe that consumption in 1926–27 was 40–50 million bushels lower than in the two preceding years, or 20–30 million bushels below average. The evidence suggests that some reduction in consumption may well have occurred, especially by comparison with 1925–26, but that the final official estimate of the crop of 1926—232 million bushels—was considerably too low.

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APPENDIX

TABLE I.—WHEAT ACREAGE IN PRINCIPAL PRODUCING AREAS, 1920–27*

(Million acres)

Year	United States	Canada	India	Australia	Argentina	Chile	Uruguay	Hungary	Bulgaria	Jugo-Slavia	Roumania	Soviet Russia	Mexico
1920	61.14	18.23	29.95	9.07	13.22	1.26	.70	2.66	2.18	3.56	5.00	.....	....
1921	63.70	23.26	25.78	9.72	14.10	1.34	.81	2.89	2.23	3.70	6.15	.....	2.28
1922	62.32	22.42	28.21	9.76	16.06	1.47	.66	3.52	2.30	3.67	6.55	.....	2.62
1923	59.66	21.87	30.85	9.54	17.04	1.54	1.06	3.29	2.38	3.84	6.65	.....	3.05
1924	52.54	22.06	31.18	10.82	15.98	1.43	.85	3.50	2.49	4.24	7.84	.....	1.40
1925	52.26	21.97	31.77	10.20	19.20[a]	1.45	.96	3.52	2.55	4.31	8.16	59.84	1.16
1926	56.53	22.99	30.47	11.06	19.28[a]	1.50	.99	3.71	2.59	4.18	8.22	69.02	1.32
1927	58.50	22.46	31.24	11.00	19.70[a]	....	1.04	3.91	2.51	4.42	7.66	.....	1.20
Average 1909–13	47.10	9.94	29.22	7.60	14.88	1.00	.79[b]	3.71	2.41	3.98	9.52[b]	74.21	2.17[c]
1921–25	58.09	22.32	29.56	10.01	16.48	1.45	.87	3.34	2.39	3.95	7.07	.....	2.10

Year	Morocco	Algeria	Tunis	Egypt	British Isles	France	Germany	Italy	Belgium	Netherlands	Denmark	Norway	Sweden
1920	1.99	3.45	1.32	1.19	1.98	12.59	3.40	11.29	.31	.15	.18	.04	.36
1921	1.96	3.04	1.49	1.46	2.08	13.30	3.56	11.88	.34	.18	.22	.04	.36
1922	2.07	3.74	1.07	1.52	2.07	13.07	3.40	11.50	.30	.15	.24	.02	.36
1923	2.25	3.17	1.61	1.54	1.84	13.67	3.65	11.45	.35	.15	.20	.03	.36
1924	2.46	3.53	1.16	1.42	1.63	13.62	3.62	11.28	.34	.12	.15	.02	.32
1925	2.62	3.61	1.62	1.38	1.57	13.87	3.84	11.67	.36	.14	.20	.02	.36
1926	2.56	3.74	1.84	1.53	1.68	12.97	3.96	12.15	.35	.13	.25	.02	.38
1927	2.27	3.48	1.04	1.66	1.71[d]	13.21	4.06	12.56	.39	.15	...	.02	.40
Average 1909–13	1.70	3.52	1.31	1.31	1.89	16.50	4.03	11.79	.40	.14	.15	.01	.26
1921–25	2.27	3.42	1.39	1.46	1.84	13.51	3.61	11.54	.34	.15	.20	.03	.35

Year	Spain	Portugal	Switzerland	Austria	Czecho-Slovakia	Poland	Finland	Latvia	Esthonia, Lithuania	Greece	Japan, Chosen	South Africa	New Zealand
1920	10.25	1.10	.12	.37	1.57	1.79	.02	.04	.19	1.08	2.18	.88	.22
1921	10.39	1.09	.12	.38	1.56	2.09	.03	.05	.21	.95	2.14	.99	.35
1922	10.31	1.16	.10	.46	1.53	2.57	.04	.07	.25	1.06	2.12	.85	.28
1923	10.49	1.05	.11	.48	1.51	2.51	.04	.11	.26	1.06	2.07	.78	.17
1924	10.38	.94	.10	.48	1.50	2.65	.04	.11	.25	1.03	2.03	.74	.17
1925	10.72	....	.11	.48	1.53	2.70	.04	.12	.33	1.07	2.04	1.06	.15
1926	10.78	1.07	.17[e]	.50	1.55	2.72	.04	.12	.36	1.15	1.15[f]	....	.22
1927	10.67	....	.17[e]	.50	1.57	2.81	.04	.14	.36	1.14	....	....	...
Average 1909–13	9.55	1.21[g]	.10	.64	1.72	3.35	.01	.08	.23	1.13[h]	1.75	.80[h]	.24
1921–25	10.46	1.06[b]	.11	.46	1.52	2.51	.04	.09	.26	1.03	2.08	.88	.22

* Data of U.S. Department of Agriculture. For 1909–13, including U.S. Department of Agriculture estimates for area within post-war boundaries. Figures for 1927 are preliminary. Dots (....) indicate that data are not available.

[a] Estimate for area sown, not harvested.
[b] Four-year average.
[c] Two-year average.
[d] Excluding Irish Free State.
[e] Including meslin and spelt.
[f] Japan only.
[g] Three-year average.
[h] One year only.

TABLE II.—WHEAT YIELD PER ACRE IN PRINCIPAL PRODUCING AREAS, 1920–27*

(Bushels per acre)

Year	United States	Canada	India	Australia	Argentina	Chile	Uruguay	Hungary	Bulgaria	Jugo-Slavia	Roumania	Soviet Russia	Mexico
1920	13.6	14.4	12.6	16.1	11.8	18.4	11.1	14.2	13.7	12.1	12.3	....	....
1921	12.8	12.9	9.7	13.3	13.5	17.6	12.3	18.3	13.1	14.0	12.8	....	2.2
1922	13.9	17.8	13.0	11.2	12.2	17.6	7.8	15.5	14.2	12.1	14.1	....	5.2
1923	13.4	21.7	12.1	13.1	14.5	18.2	12.6	20.6	12.2	15.9	15.4	....	4.5
1924	16.5	11.9	11.6	15.2	12.0	17.1	11.7	14.7	9.9	13.6	9.0	....	7.4
1925	12.9	18.7	10.4	11.2	10.0	18.3	10.4	20.3	19.5	18.2	12.8	11.9	8.1
1926	14.7	17.8	10.7	14.5	11.5	15.5	10.3	20.2	15.9	17.1	13.5	11.7	7.8
1927	14.8	19.8	10.7	10.5	11.4	....	....	19.4	18.9	12.8	12.6	....	9.6
Average													
1909–13	14.7	19.8	12.0	11.9	9.9	20.0	8.2	19.3	15.7	15.6	16.7[a]	10.2	...
1921–25	13.8	16.6	11.4	12.8	12.3	17.8	11.2	17.8	13.8	14.9	12.7	....	5.0

Year	Morocco	Algeria	Tunis	Egypt	British Isles	France	Germany	Italy	Belgium	Netherlands	Denmark	Norway	Sweden
1920	9.0	4.7	4.0	26.6	28.7	18.8	24.3	12.5	33.6	39.4	41.1	25.0	28.8
1921	11.9	9.4	6.0	25.4	35.4	24.3	30.3	16.3	42.3	47.6	50.7	23.7	34.3
1922	6.2	5.1	3.4	24.1	31.5	18.6	21.2	14.2	35.4	41.1	39.0	25.7	26.7
1923	8.9	11.3	6.2	26.5	31.8	20.2	29.1	19.6	38.8	40.3	43.2	23.5	30.4
1924	11.6	4.9	4.5	24.1	33.0	20.6	24.6	15.1	38.2	39.9	39.4	23.5	21.1
1925	9.1	9.1	7.2	26.2	34.1	23.8	30.8	20.6	39.7	40.6	49.2	22.3	36.8
1926	6.3	6.3	7.1	24.3	31.0	17.9	24.1	18.2	36.6	41.6	35.4	26.6	32.4
1927	10.9	9.5	5.3	26.8	31.7[b]	21.5	....	15.6	37.0	36.0	....	29.2	28.2
Average													
1909–13	10.0	10.0	4.8	25.6	31.6	19.7	32.6	15.6	37.6	36.1	41.1	25.5	31.8
1921–25	9.6	7.8	5.7	25.3	33.2	21.5	27.3	17.2	39.0	42.2	44.5	23.8	30.1

Year	Spain	Portugal	Switzerland	Austria	Czecho-Slovakia	Poland	Finland	Latvia	Esthonia, Lithuania	Greece	Japan, Chosen	South Africa	New Zealand
1920	13.5	9.4	30.1	14.6	16.8	12.7	12.1	10.0	13.4	10.4	18.9	8.7	31.2
1921	14.0	7.4	32.5	17.3	24.9	17.9	20.7	17.0	15.9	10.8	18.6	8.8	29.9
1922	12.2	8.5	24.3	16.1	22.0	16.5	18.7	13.7	17.0	8.5	18.5	7.4	30.4
1923	15.0	12.5	34.5	18.7	24.0	19.8	17.2	15.5	14.3	8.3	17.0	7.7	24.0
1924	11.7	9.1	29.9	17.6	21.5	12.3	21.4	14.9	15.2	8.0	18.4	9.6	32.6
1925	15.2	....	32.0	22.0	25.8	21.4	25.1	18.2	18.5	13.3	19.6	7.4	30.4
1926	13.6	8.0	23.1	18.9	22.0	17.3	23.7	15.2	13.9	9.7	24.2[c]	....	34.1
1927	13.6	....	24.9	20.7	24.1	19.4	23.1	15.6	....	11.7	....	....	....
Average													
1909–13	13.7	....	31.6	20.2	22.0	19.0	17.1	17.4	15.5	14.4[d]	18.2	7.5[d]	28.7
1921–25	13.6	9.7[a]	30.8	18.4	23.6	17.5	20.4	16.0	16.3	9.8	18.5	8.1	29.6

* Computed from acreage and production figures in Appendix Tables I and III. Dots (....) indicate that data are not available.

[a] Four-year average.
[b] England and Wales only.
[c] Japan only.
[d] One year only.

Table III.—Wheat Production in Principal Producing Areas, 1920–27*

(Million bushels)

Year	United States	Canada	India	Australia	Argentina	Chile	Uruguay	Hungary	Bulgaria	Jugo-Slavia	Roumania	Soviet Russia	Mexico
1920	833.0	263.2	377.9	145.9	156.1	23.2	7.8	37.9	30.0	43.0	61.3	.....	15.0
1921	814.9	300.9	250.4	129.1	191.0	23.6	10.0	52.7	29.2	51.8	78.6	.....	5.1
1922	867.6	399.8	367.0	109.5	195.8	25.9	5.2	54.7	32.6	44.5	92.0	.....	13.6
1923	797.4	474.2	372.4	125.0	247.8	28.1	13.3	67.7	29.1	61.1	102.1	.....	13.7
1924	864.4	262.1	360.6	164.6	191.1	24.5	9.9	51.6	24.7	57.8	70.4	.....	10.4
1925	676.4	411.4	331.0	114.5	191.1	26.6	10.0	71.7	49.6	78.6	104.7	713.0	9.4
1926	832.8	409.8	324.7	160.9	220.8	23.3	10.2	74.9	41.1	71.4	110.9	809.6	10.3
1927	866.5	444.3	334.1	115.0	225.0	....	....	75.8	47.4	56.5	96.8	.....	11.5
Average 1909–13	690.1	197.1	351.8	90.5	147.1	20.1	6.5[a]	71.5	37.8	62.0	158.7[a]	758.9	11.5[a]
1921–25	804.2	369.7	336.3	128.5	203.4	25.7	9.7	59.7	33.1	56.5	89.6	.....	10.4

Year	Morocco	Algeria	Tunis	Egypt	British Isles	France	Germany	Italy	Belgium	Netherlands	Denmark	Norway	Sweden
1920	17.9	16.2	5.2	31.7	56.8	236.9	82.6	141.3	10.3	6.0	7.4	1.00	10.3
1921	23.2	28.5	9.0	37.0	73.8	323.5	107.8	194.1	14.5	8.6	11.1	.97	12.3
1922	12.9	18.9	3.7	36.6	65.2	243.3	71.9	161.6	10.6	6.2	9.2	.64	9.5
1923	20.0	35.8	9.9	40.7	58.4	275.6	106.4	224.8	13.4	6.2	8.9	.59	11.0
1924	28.7	17.2	5.2	34.2	53.9	281.2	89.2	170.1	13.0	4.7	5.9	.49	6.8
1925	23.9	32.7	11.8	36.2	53.7	330.8	118.2	240.8	14.5	5.6	9.7	.49	13.4
1926	16.2	23.6	13.0	37.2	52.2	231.8	95.4	220.6	12.8	5.5	8.8	.59	12.4
1927	24.8	33.1	5.5	44.3	51.8[b]	284.4	113.6	195.8	14.4	5.4	....	.58	11.3
Average 1909–13	17.0	35.2	6.2	33.7	59.6	325.6	131.3	184.4	15.2	5.0	6.3	.31	8.1
1921–25	21.7	26.6	7.9	36.9	61.0	290.9	98.7	198.3	13.2	6.2	9.0	.64	10.6

Year	Spain	Portugal	Switzerland	Austria	Czecho-Slovakia	Poland	Finland	Latvia	Esthonia, Lithuania	Greece	Japan, Chosen	South Africa	New Zealand
1920	138.6	10.4	3.6	5.4	26.4	22.7	.27	.39	2.58	11.2	41.1	7.6	6.9
1921	145.1	9.3	3.8	6.5	38.7	37.4	.58	.78	3.34	10.3	39.7	8.7	10.6
1922	125.5	10.0	2.5	7.4	33.6	42.4	.71	.96	4.17	9.0	39.8	6.3	8.4
1923	157.1	13.2	3.8	8.9	36.2	49.7	.69	1.64	3.70	8.8	35.2	6.0	4.2
1924	121.8	8.6	3.1	8.5	32.2	32.5	.79	1.58	3.86	8.3	37.3	7.1	5.4
1925	162.6	11.5	3.5	10.7	39.3	57.8	.93	2.16	6.08	14.2	40.0	7.8	4.6
1926	146.6	8.5	4.0	9.4	34.1	47.1	.92	1.86	5.02	11.2	39.9	8.5	7.5
1927	145.6	11.3	4.3	10.4	37.9	54.6	.90	2.18	5.39[c]	13.3	37.8	...	....
Average 1909–13	130.4	11.8[d]	3.3	12.8	37.9	63.7	.14	1.48	3.63	16.3[d]	32.0	6.0[d]	6.9
1921–25	142.4	10.5	3.3	8.4	36.0	44.0	.74	1.43	4.23	10.1	38.4	7.2	6.6

* Data of U.S. Department of Agriculture. For 1909–13, including U.S. Department of Agriculture estimates for area within post-war boundaries. Dots (....) indicate that data are not available.

[a] Four-year average.
[b] England and Wales.
[c] Includes estimate for winter wheat only for Esthonia.
[d] One year only.

TABLE IV.—RYE PRODUCTION IN PRINCIPAL PRODUCING AREAS, 1920–27*

(Million bushels)

Year	United States	Canada	Argentina	Hungary	Bulgaria	Jugo-Slavia	Roumania	Soviet Russia	France	Germany	Italy	Belgium	Netherlands
1920.....	60.5	11.3	0.8	20.6	6.2	6.1	9.4	.....	34.5	194.2	4.5[a]	18.2	14.8
1921.....	61.7	21.5	1.7	23.2	6.1	6.2	9.1	.....	44.4	267.6	6.5	21.3	15.0
1922.....	103.4	32.4	3.5	25.1	6.4	4.5	9.2	.....	38.4	206.0	5.6	18.4	17.1
1923.....	63.1	23.2	4.0	31.3	5.2	5.9	9.6	.....	36.5	263.0	6.5	20.8	14.6
1924.....	65.5	13.8	1.5	22.1	4.3	5.5	6.0	.....	40.2	225.6	6.1	20.7	15.6
1925.....	46.5	13.7	4.7	32.5	8.9	7.9	8.0	815.5	43.7	317.4	6.7	21.7	16.4
1926.....	41.0	12.1	3.3	31.4	8.0	7.5	11.2	897.3	30.1	252.2	6.5	20.1	13.6
1927.....	61.5	16.1	...	22.6	8.4	5.9	9.8	.....	36.8	286.3	5.9	20.1	13.5
Average													
1909–13.....	36.1	2.1	0.6	31.4	8.3	9.0	20.6[b]	735.5	52.5	368.3	6.3	23.6	16.4
1921–25.....	68.0	20.9	3.1	26.8	6.2	6.0	8.4	.....	40.6	255.9	6.3	20.6	15.7

Year	Denmark, Norway	Sweden	Spain	Portugal	Switzerland	Austria	Czecho-Slovakia	Poland	Finland	Latvia	Esthonia	Lithuania	Greece
1920.....	14.0	22.4	27.8	5.2	1.6	10.1	32.9	73.7	7.1	4.7	6.2	16.7	1.0
1921.....	13.2	26.6	28.1	4.6	1.6	13.2	53.7	167.6	11.7	9.8	5.9	21.0	1.1
1922.....	15.1	22.1	26.3	5.4	1.7	13.6	51.1	197.4	10.5	6.8	5.8	25.4	1.1
1923.....	15.9	23.4	28.1	5.2	1.6	15.8	53.3	234.7	9.4	10.8	6.6	23.8	0.6
1924.....	11.1	10.9	26.3	6.8	1.4	16.2	44.7	143.9	11.3	7.9	5.5	18.3	0.5
1925.....	14.4	26.6	29.9	4.6	1.6	21.7	58.1	257.4	13.7	12.4	7.2	26.1	1.0
1926.....	13.1	23.3	23.5	3.6	1.6	18.7	45.9	197.3	11.9	6.1	4.5	13.8	1.4
1927.....	0.6[c]	18.9	27.1	4.4	1.7	18.2	48.9	235.6	12.1	11.9	6.6	21.0	1.2
Average													
1909–13....	20.1	24.1	27.6	2.3	1.8	23.8	63.5	218.9	10.5	13.1	8.1	24.3	1.1
1921–25.....	13.9	21.9	27.7	5.3	1.6	16.1	52.2	200.2	11.3	9.5	6.2	22.9	0.9

* See corresponding footnote under Table III.

[a] Old boundaries. [b] Four-year average. [c] Norway only.

TABLE V.—POTATOES AND CORN PRODUCTION IN PRINCIPAL EUROPEAN PRODUCING COUNTRIES, 1920–26*

(Million bushels)

Year	Potatoes							Corn (maize)					
	British Isles	France	Germany	Belgium, Holland	Czecho-Slovakia	Poland	Soviet Russia[a]	Hungary	Bulgaria	Jugo-Slavia	Roumania	Soviet Russia[a]	Italy
1920.....	238	428	1,024	204	184	665	.....	50.2	20.9	101.1	182.0	.....	89.3
1921.....	245	305	961	179	159	617	.....	31.7	16.4	73.8	110.6	.....	92.3
1922.....	321	465	1,494	307	333	1,221	.....	48.7	15.5	89.8	119.8	.....	76.8
1923.....	222	364	1,197	211	229	974	.....	49.2	26.9	84.8	151.4	.....	89.2
1924.....	219	564	1,338	223	239	987	.....	74.1	24.8	149.4	155.5	.....	105.7
1925.....	281	558	1,533	247	276	1,069	1,627	88.0	28.2	149.2	163.7	197.8	110.0
1926.....	249	409	1,103	215	186	914	1,866	76.5	29.0	134.3	239.5	145.9	118.1
Average													
1909–13.....	254	527	1,374	215	245	890	740	60.8	26.3	111.9	193.2[b]	52.2	102.7
1921–25.....	257	451	1,304	233	247	974	.....	58.4	22.3	109.4	140.2	.....	94.8

* See corresponding footnote under Table III.

[a] European and Asiatic territory. [b] Four-year average.

TABLE VI.—UNITED STATES WHEAT ACREAGE, 1920–27*

(Million acres)

Crop of	Winter wheat			Spring wheat harvested	Total harvested
	Planted	Abandoned	Harvested		
1920.....	44.9	4.84	40.0	21.1	61.1
1921.....	45.6	2.21	43.4	20.3	63.7
1922.....	47.9	5.57	42.4	20.0	62.3
1923.....	46.1	6.58	39.5	20.2	59.7
1924.....	38.9	3.26	35.7	16.9	52.5
1925.....	39.8	8.61	31.2	21.0	52.3
1926.....	39.8	2.89	36.9	19.6	56.5
1927.....	42.8	4.58	38.2	20.3	58.5
Average 1909–13..	32.0	3.60	28.4	18.7	47.1
1921–25..	43.7	5.24	38.4	19.7	58.1

* Official data of U.S. Department of Agriculture. See especially *Agriculture Yearbook, 1926,* p. 803, and crop reports. Latest figures include substantial revisions for 1924, 1925, and 1926.

TABLE VII.—UNITED STATES WHEAT CROP FORECASTS AND ESTIMATES, 1925, 1926*

(Million bushels)

Date	1925 Official	1926 Official	1926 Bryant	1926 Cromwell	1926 Murray	1926 Snow
	WINTER WHEAT					
Apr. 1....	.....	.....	589	565	570	563
May 1....	444.8	548.9	574	559	574	554
June 1....	407.2	543.3	532	567	564	582
July 1....	403.9	567.8	555	569	561	564
Aug. 1....	415.7	626.5	596	601	630	643
Sept. 1....	415.7	626.5	596	621	630	647
Oct. 1....	415.7	626.5	596	621	630	640
Dec. 1[a] ...	398.5	626.9	...	...	...	...
	SPRING WHEAT					
June 1....	253.7	.....	203	223	222	218
July 1....	275.7	199.6	205	211	207	207
Aug. 1....	262.7	212.7	197	188	213	208
Sept. 1....	283.9	212.1	203	214	218	224
Oct. 1....	281.6	213.3	204	209	213	216
Dec. 1[a] ...	270.9	205.4	...	...	...	...
	TOTAL WHEAT					
June 1....	660.9	.....	735	790	786	800
July 1....	679.6	767.4	760	780	768	771
Aug. 1....	678.4	839.2	793	789	843	851
Sept. 1....	699.6	838.6	799	835	848	871
Oct. 1....	697.3	839.8	800	830	843	856
Dec. 1[a] ...	669.4	832.3	...	...	...	...

* Data from official and commercial crop reports and *Daily Market Record,* Minneapolis.

[a] The figures given are the revisions made as of December 1 in the years 1925 and 1926 respectively. The final estimates for the 1925 crop, published in December 1926, were as follows, in million bushels: 401.7, winter; 274.7, spring; 676.4, total.

TABLE VIII.—UNITED STATES WHEAT PRODUCTION BY GRADES, 1921–26*

(Percentages of total crops)

Crop of	No. 1	No. 2	No. 3	No. 4	No. 5	Other
	WINTER WHEAT					
1921.....	19.7	39.9	25.1	10.2	3.5	1.6
1922.....	13.3	38.0	27.6	13.1	5.2	2.8
1923.....	20.8	42.8	21.7	9.2	3.7	1.8
1924.....	30.3	42.8	16.8	6.7	2.3	1.1
1925.....	28.0	45.4	17.9	6.0	1.6	1.1
1926.....	49.6	33.6	11.5	3.1	1.5	0.7
	SPRING WHEAT					
1921.....	24.1	25.6	24.2	15.1	7.9	3.1
1922.....	52.1	26.4	13.5	5.3	2.0	0.7
1923.....	18.8	26.4	24.1	16.3	8.8	5.6
1924.....	62.9	21.5	10.1	3.7	1.0	0.8
1925.....	37.5	28.0	18.8	9.2	4.8	1.7
1926.....	....[a]	....[a]	....[a]	....[a]	...[a]	...[a]

* Data of U.S. Department of Agriculture: *Crops and Markets, Monthly Supplement,* December 1925, p. 403; *Crops and Markets,* March 1927, p. 89. Earlier data not available.

[a] Data not yet available.

TABLE IX.—UNITED STATES WHEAT PRODUCTION BY CLASSES, 1920–27*

(Million bushels)

Crop of	Hard red spring	Durum	Hard red winter	Soft red winter	Pacific white	Total
1920.....	139	52	303	247	91	833
1921.....	131	57	290	238	99	815
1922.....	170	91	280	248	79	868
1923.....	126	55	242	272	102	797
1924.....	192	66	365	189	52	864
1925.....	156	65	206	170	80	676
1926.....	122	49	361	227	73	832
1927.....	191	84	320	177	94	866
Average 1921–25..	155	67	277	223	82	804

* Classification by U.S. Department of Agriculture. See especially *Agriculture Yearbooks,* and *Foreign News on Wheat: World Wheat Crop and Market Prospects,* October 22, 1927, p. 8. These are estimates only, and are made on a basis which does not lead to highly reliable results.

TABLE X.—UNITED STATES WINTER AND SPRING WHEAT ACREAGE, PRODUCTION, AND YIELD PER ACRE, 1920–27*

Year	Acreage (million acres)		Production (million bushels)		Yield per acre (bushels per acre)	
	Winter	Spring	Winter	Spring	Winter	Spring
1920.....	40.02	21.13	610.6	222.4	15.3	10.5
1921.....	43.41	20.28	600.3	214.6	13.8	10.6
1922.....	42.36	19.96	586.9	280.7	13.8	14.1
1923.....	39.51	20.15	571.8	225.6	14.5	11.2
1924.....	35.66	16.88	592.3	272.2	16.6	16.1
1925.....	31.23	21.02	401.7	274.7	12.9	13.1
1926.....	36.94	19.61	627.4	205.4	17.0	10.5
1927.....	38.18[a]	20.31[a]	552.8[a]	313.8[a]	14.5[a]	15.4[a]
Average 1921–25..	38.43	19.66	550.6	253.6	14.3	12.9

* Data of U. S. Department of Agriculture. See especially *Agriculture Yearbook, 1926*, p. 803, and press releases.

[a] November estimate.

TABLE XI.—CANADIAN WHEAT PRODUCTION FORECASTS AND ESTIMATES, 1922–27*

(Million bushels)

Date	1922	1923	1924	1925	1926	1927
June 30.....	339	366	319	365	349	325
July 31.....	321	383	282	375	317	357
Aug. 31.....	389	470	292	392	399	459
Oct. 31.....	391	470[a]	272	422	406	444
Dec. 31.....	400	474	262	411	410	...

* Canadian Dominion Bureau of Statistics, *Monthly Bulletin of Agricultural Statistics*, and press releases. See Appendix Table XXXII for evidence respecting apparent errors in crop estimates.

[a] September 30.

TABLE XII.—BROOMHALL'S FORECASTS OF EXPORTERS' SURPLUSES AND IMPORTERS' PURCHASES, 1926–27*

(Million bushels)

Date of report	Available for export	Margin over importers' purchases	Importers' purchases		
			Total	Europe	ex-Europe
Aug. 10...	768	64	704	560	144
Sept. 14...	816	112	704	576	128
Nov. 2...	832	128	704	576	128
Nov. 9...	856	152	704	576	128
Dec. 14...	868	164	704	576	128
Jan. 25...	868	148	720	600	120
Mar. 22...	908	148	760	640	120
May 24...	907	115	792	656	136

* Data from Broomhall's *Corn Trade News*.

TABLE XIII.—UNITED STATES IMPORTS OF WHEAT AND FLOUR FROM CANADA, 1920–21 TO 1926–27*

(Million bushels)

Crop year July–June	Withdrawn for consumption, duty-paid	Withdrawn for milling in bond, free	General imports[a]		
			Wheat grain	Flour as wheat	Total
1920–21.....	.....[b]	.....[b]	50.69	6.39	57.08
1921–22.....	8.46[c]	6.17[d]	14.46	2.79	17.25
1922–23.....	7.41	9.28	18.01	1.94	19.95
1923–24.....	13.68	13.90	27.28	0.76	28.04
1924–25.....	0.27	5.81	6.17	0.03	6.20
1925–26.....	1.64	13.47	15.60	0.08	15.68
1926–27.....	0.05	13.17	13.24	0.27	13.51

* Data of U.S. Department of Commerce, in part compiled from *Monthly Summary of Foreign Commerce*, and *Agriculture Yearbook, 1925*, p. 762; in part supplied direct.

[a] Practically all from Canada. No deduction made for re-exports, which rarely reach 1 million bushels.

[b] Distinction established by emergency tariff act effective May 28, 1921. Before this date no duties had been in force since April 17, 1917.

[c] Including June 1921.

[d] Nine months only (October–June).

TABLE XIV.—CANADIAN WHEAT AND FLOUR EXPORTS OVERSEAS, 1920–21 TO 1926–27*

(Million bushels)

Crop year Aug.–July	Total	Through U.S. ports	Through all Canadian ports	Through Vancouver alone
1920–21[a].....	112.3[a]	63.6[a]	48.7[a]	1.1[a]
1921–22.....	168.0	109.7	58.3	9.4[a]
1922–23.....	263.3	150.8	112.5	21.5[a]
1923–24.....	323.6	164.7	158.8	58.4[b]
1924–25.....	189.5	99.1	90.4	26.0
1925–26.....	314.0	161.3	152.7	58.7
1926–27.....	285.2	150.8	134.4	39.6

* Official data from *Reports on the Grain Trade of Canada* and *Canadian Grain Statistics*. These figures do not include exports by lake and rail to the United States; hence the totals do not represent Canada's gross or net exports.

[a] September–August.

[b] Eleven months, September–July.

TABLE XV.—MONTHLY WHEAT RECEIPTS AT PRIMARY MARKETS IN THE UNITED STATES AND CANADA*

(Million bushels)

Month	United States primary markets				Fort William and Port Arthur				Vancouver			
	1923–24	1924–25	1925–26	1926–27	1923–24	1924–25	1925–26	1926–27	1923–24	1924–25	1925–26	1926–27[a]
Aug.	65.3	93.0	43.3	71.6	2.0	1.3	1.2	1.5	.00	.21	.55	.12
Sept.	45.3	82.1	57.9	48.7	28.3	7.1	45.7	32.8	.22	.41	.28	.29
Oct.	40.5	88.0	36.1	37.1	67.1	40.9	53.2	56.1	3.23	3.98	7.04	6.37
Nov.	37.2	60.5	34.1	29.8	72.5	42.7	51.5	60.5	3.04	5.05	9.79	7.22
Aug.–Nov.	188.3	323.6	171.4	187.2	169.9	92.0	151.6	150.9	6.49	9.65	17.66	14.00
Dec.	28.4	36.3	34.9	22.4	51.9	20.3	53.5	26.3	6.76	4.21	6.14	6.63
Jan.	15.9	24.7	21.6	24.6	12.7	4.1	10.5	14.0	7.27	3.84	10.03	6.83
Feb.	19.8	19.9	16.2	21.0	3.9	6.2	4.0	8.6	7.32	2.08	7.74	4.27
Mar.	18.0	17.3	15.1	16.6	2.5	8.5	3.2	6.3	8.09	.74	6.98	5.74
Dec.–Mar.	82.1	98.2	87.8	84.6	71.0	39.1	71.2	55.2	29.44	10.87	30.89	23.47
Apr.	10.1	10.4	14.0	14.4	6.4	8.1	1.8	12.6	6.47	1.02	3.58	3.25
May	15.4	17.6	15.7	19.2	15.8	7.0	17.2	17.3	5.24	1.54	1.20	1.40
June	16.4	21.9	21.0	20.7	21.2	4.1	13.6	7.3	3.05	.74	.22	.59
July	35.1	41.8	77.0	58.8	13.1	6.7	6.4	10.7	1.31	.11	.27	.15
Apr.–July	77.0	91.7	127.7	113.1	56.5	25.9	39.0	47.9	16.07	3.41	5.27	5.39
Aug.–July	347.4	513.5	386.9	384.9	297.4	157.0	261.8	254.0	52.00	23.93	53.82	42.86

* United States data are unofficial figures compiled from *Survey of Current Business;* Canadian data are official figures from *Reports on the Grain Trade of Canada* and *Canadian Grain Statistics.* Vancouver data for 1925–26 and 1926–27 are derived from weekly figures.

[a] Receipts at Prince Rupert included with receipts at Vancouver for the period between October 1, 1926, and April 1, 1927.

TABLE XVI.—INTERNATIONAL SHIPMENTS OF WHEAT AND RYE (BROOMHALL), ANNUALLY FROM 1920–21*

(Million bushels)

Crop year ending approximately August 1	Wheat, including wheat flour									Rye, including rye flour			
	North America	Argentina, Uruguay	Australia	Russia, Danube	India	Other	Total	To Europe	To Ex-Europe	North America	Russia, Danube	Other	Total
1920–21	432.2	63.9	82.1	1.6	11.2	....	591.0	541.5	49.5	40.0	1.3	1.7	43.0
1921–22	404.0	118.4	110.8	5.6	.2	8.1	647.1	546.7	100.4	34.9	.02	1.3	36.2
1922–23	455.2	138.3	47.8	6.9	26.1	2.1	676.4	585.9	90.5	58.7	2.7	1.5	62.9
1923–24[a]	454.4	174.4	77.9	36.0	17.5	15.1	775.3	626.5	148.8	26.8	41.3	....	68.1
1924–25	422.6	121.4	117.1	13.5	31.7	8.9	715.2	639.7	75.5	61.9	.4	.1	62.4
1925–26	413.2	93.9	74.0	32.7	4.9	48.8[b]	667.6	532.3	135.3	15.1	3.9	19.2[c]	38.2
1926–27	484.4	139.0	103.8	48.8	10.2	28.8	815.0	683.0	132.0	32.5	8.1	6.6	47.2
Average 1910–14	206.9	82.5	54.9	225.2	47.1	8.1	624.7	542.7	82.0	.9	24.3	28.8[c]	54.0
1921–26	429.9	129.3	85.5	18.9	16.1	16.6	696.3	586.2	110.1	39.5	9.7	4.4	53.6

* Data from *Corn Trade News.* Figures are Broomhall's cumulative totals, presumably including revisions of his weekly shipment figures. Dots (....) indicate no shipments reported.

[a] For 53 weeks. [b] Largely Germany and Poland. [c] Chiefly Germany.

TABLE XVII.—INTERNATIONAL TRADE IN WHEAT (INCLUDING FLOUR), ANNUALLY FROM 1920–21*

(Million bushels)

A.—NET EXPORTS

Crop year August–July	United States	Canada	India	Australia	Argentina	Chile	Hungary	Bulgaria	Jugo-Slavia	Roumania	Russia	Morocco
1920–21	307.9	165.8	15.1	88.9	64.0	2.2[a]	(.01)	1.77	3.76	1.41	....	0.3[a]
1921–22	251.8	185.4	(13.8)	114.6	118.1	0.1[a]	9.40	4.52	3.90	3.51	....	0.7[a]
1922–23	200.2	279.0	28.6	50.3	139.4	1.5[a]	5.15	4.32	1.01	1.64	....	0.2[a]
1923–24	127.4	346.1	20.1	85.6	172.2	5.6	16.79	2.45	5.84	8.98	23.2[b]	1.7[a]
1924–25	256.4	192.1	38.1	123.6	123.1	7.7	13.54	(1.70)	9.55	3.21	(9.4)[b]	0.7[a]
1925–26	103.4	324.1	8.0	77.2	94.4	1.0	19.79	4.37	11.59	9.93	27.1	0.8[a]
1926–27	198.6	292.7	13.9[c]	102.7	143.0	0.5[c]	21.99	1.83[d]	9.74	10.79[e]	49.4	...
Average												
1909–14	110.0	95.6	49.8	55.2	84.7	2.4[a]	43.14[f]	11.27[f]	....	54.62[f]	164.5[f]	0.3[a]
1921–26	187.8	265.3	16.2	90.3	129.4	2.9[a]	12.93	2.79	6.38	5.46	....	0.8[a]

B.—NET IMPORTS

Crop year August–July	Algeria	Tunis	Egypt	United Kingdom	Irish Free-St.	France	Germany	Italy	Belgium	Netherlands	Denmark	Norway
1920–21	5.6	1.3	11.21	200.1		68.3	59.8[g]	99.4	32.2	18.9	0.35	3.86
1921–22	(4.2)	(1.3)	6.84	208.2		17.1	69.5[g]	100.5	40.5	19.8	4.01	5.16
1922–23	2.3	0.7	7.68	205.5[h]	4.8[h]	45.6	37.5[g]	115.7	39.5	23.9	6.28	6.90
1923–24	(7.2)	(2.8)	8.52	219.4	20.3	53.3	30.7[a]	69.9	40.0	26.7	9.28	6.11
1924–25	0.5	(0.2)	9.90	208.8	19.1	58.5[i]	80.9[g]	88.7	39.0	26.8	6.55	5.57
1925–26	(4.6)	(2.6)	12.79	191.1	18.8	10.3[i]	57.4	67.7	39.2	27.2	6.00	6.70
1926–27	1.6	(0.3)	8.77	217.3	19.7	62.0[i]	91.8	86.6	39.5	28.4	7.27	6.22
Average												
1909–14	(5.3)	0.8	0.02	217.7		43.6[f]	67.8[f]	53.0[f]	50.2[f]	22.6	6.66[f]	3.78
1921–26	(2.6)	(1.2)	9.14	206.4[j]	19.4[j]	36.9	55.2	88.5	39.6	24.9	6.42	6.09

B.—NET IMPORTS (*concluded*)

Crop year August–July	Sweden	Spain	Portugal	Switzerland	Austria	Czecho-Slovakia	Poland	Finland	Latvia	Esthonia	Greece	Japan
1920–21	6.61	19.83	6.6[a]	12.9	14.6	18.3	....	2.47	0.58	0.61[a]	10.6	5.8
1921–22	3.85	8.02	8.1[a]	13.2	19.0	11.6	1.20	3.39	0.74	0.76[a]	13.7	24.9
1922–23	8.78	(0.18)	6.5[a]	16.6	13.4	10.2	2.52	5.12	1.11	1.18[a]	17.5	14.5
1923–24	12.35	(0.32)	3.2[a]	17.1	18.1	21.2	2.63	5.12	1.80	0.97	18.8	29.1
1924–25	10.58	0.80	6.0[a]	13.9	14.7[e]	21.5	17.10	4.54	1.94	0.86	20.8	12.2
1925–26	6.10	(0.73)	...	15.6	14.7[k]	21.7	(4.60)	5.23	1.56	0.97	....	22.7
1926–27	6.09	(0.69)[l]	...	16.3	15.4[e]	20.1	8.07	5.19	1.67	0.90	....	18.7[e]
Average												
1909–14	7.07	6.19	3.0[a]	16.9	10.5[f]	....	....	....	....	....	6.9[a]	4.1
1921–26	8.33	1.52	5.9[am]	15.3	16.0	17.2	3.77	4.68	1.43	0.95	17.7[m]	20.7

* Data from official sources, in large part through International Institute of Agriculture. Figures in parentheses represent, under *A*, net imports, and under *B*, net exports. Dots (....) indicate that data are unavailable or that comparable averages cannot be computed.

[a] Calendar years 1921 and following; averages for calendar years 1909–13 and 1922–26.

[b] Broomhall's shipments, probably incomplete.

[c] Gross figure.

[d] Seven months.

[e] Eleven months.

[f] For pre-war boundaries; not comparable with post-war figures.

[g] Data incomplete because of territory occupied by foreign armies.

[h] Irish Free State separated after April 1, 1923.

[i] Statistics for 1924–25 and 1925–26 adjusted for imports of wheat under decree of December 30, 1924, permitting refund of duty. Figure for 1926–27 probably too low. For discussion see WHEAT STUDIES, II, 211 n., and III, 427 n. From January 11, 1925, French shipments to the Saar region have not been counted as exports from France. These, consisting largely of flour, were 1.5 million bushels in 1922, 2.0 in 1923, and 3.2 in 1924.

[j] Three-year average.

[k] July–June figure.

[l] Eight months.

[m] Four-year average.

TABLE XVIII.—INTERNATIONAL TRADE IN WHEAT FLOUR, ANNUALLY FROM 1920–21*

(Thousand barrels of 196 pounds)

A.—NET EXPORTS

Crop year August–July	United States	Canada	India	Australia	Argentina	Chile	Hungary	Bulgaria	Jugo-Slavia	Roumania
1920–21	13,665	6,688	835	2,281	353	138[a]	(2)	83	426	150
1921–22	14,900	7,701	497	3,677	950	100[a]	1,863	242	392	115
1922–23	14,457	10,936	538	4,081	842	151[a]	1,137	166	163	293
1923–24	17,020	11,933	708	5,222	1,772	181	2,333	147	417	936
1924–25	13,882	10,108	892	4,625	1,625	196	2,025	(23)	697	619
1925–26	9,551	10,847	685	5,003	1,648	48	1,817	465	456	849
1926–27	13,378	9,238	719[c]	5,313	1,730	82[c]	1,588	290[d]	311	922
Average 1909–14	10,639	3,898	613	1,802	1,307	67[a]	7,443[f]	502[f]	...	1,092[f]
1921–26	13,962	10,305	664	4,523	1,368	143[a]	1,835	199	425	562

B.—NET IMPORTS

Crop year August–July	France	Italy	Belgium	Spain	Algeria	Tunis	Egypt	United Kingdom	Irish Free St.	Germany
1920–21	(66)	123	(2)	163	205	(4)	2,046	6,552	.....	306[g]
1921–22	(372)	(91)	(237)	(53)	(36)	20	1,478	7,559	.....	61[g]
1922–23	(478)	(393)	24	(43)	80	79	1,636	5,579[h]	607[h]	566[g]
1923–24	(254)	(1,493)	(480)	(66)	(62)	(34)	1,798	2,764	2,126	4,166[g]
1924–25	(393)	(1,246)	(787)	(59)	55	95	1,906	1,465	1,892	5,384[g]
1925–26	(260)	(336)	(151)	(157)	5	...[m]	2,436	2,483	1,748	1,411
1926–27	(16)	(193)	(65)	(148)[k]	36	(24)	1,891	4,022	1,757	491
Average 1909–14	(133)[f]	(793)[f]	(704)	(12)	(126)	189	1,760[a]	5,193		(1,827)[f]
1921–26	(351)	(712)	(326)	(75)	8	32	1,851	5,244		2,918

B.—NET IMPORTS (*concluded*)

Crop year August–July	Nether-lands	Denmark	Norway	Sweden	Austria	Czecho-Slovakia	Poland	Finland	Greece	Japan
1920–21	592	45	241	272	1,361	3,135	.....	432	229	157
1921–22	560	555	456	34	1,811	2,130	115	724	149	559
1922–23	659	555	603	75	2,016	1,996	535	1,091	1,099	147
1923–24	1,286	476	635	264	2,607	3,584	530	1,098	1,301	37
1924–25	698	201	560	146	1,580[e]	3,094	3,326	973	1,324	(518)
1925–26	1,269	495	775	(17)	1,279[k]	3,252	43	1,115	.....	(1,016)
1926–27	1,751	691	611	77	1,587[e]	1,690	76	1,109	.....	193
Average 1909–14	2,028	586[f]	639	87	.....	.....	.....	.....	92[a,f]	181
1921–26	894	456	606	104	1,858	2,811	910	1,000	966[i]	(158)

* For footnotes see under Table XVII, except as follows: [m] Net import of 224 barrels.

TABLE XIX A.—EXPORTS OF WHEAT AND FLOUR AS WHEAT TO JAPAN FROM NORTH AMERICA AND AUSTRALIA, ANNUALLY FROM 1921–22*

(Million bushels)

Year July–June	Wheat and flour			Wheat and flour from			Wheat from			Flour from		
	Total	Wheat	Flour	United States	Canada	Australia	United States	Canada	Australia	United States	Canada	Australia
1921–22.....	25.39	21.85	3.54	13.96	3.62	7.81	11.00	3.35	7.50	2.96	.27	.31
1922–23.....	14.08	12.11	1.97	6.50	3.79	3.79	5.35	3.05	3.71	1.15	.74	.08
1923–24.....	32.12	30.29	1.83	11.06	7.25	13.81	10.26	6.96	13.07	.80	.29	.74
1924–25.....	14.89	14.55	.34	4.35	3.51	7.03	4.10	3.43	7.02	.25	.08	.01
1925–26.....	29.66	29.07	.59	5.28	13.48	10.90	5.18	13.03	10.86	.10	.45	.04
1926–27.....	19.97	19.27	.70	7.34	8.30	4.33	7.34	7.63	4.30	.00	.67	.03

* Data from official trade statistics of the three exporting countries.

TABLE XIX B.—EXPORTS OF WHEAT AND FLOUR AS WHEAT TO CHINA, HONGKONG AND KWANTUNG, FROM NORTH AMERICA AND AUSTRALIA, ANNUALLY FROM 1921–22*

(Million bushels)

Year July–June	Wheat and flour			Wheat and flour from			Wheat from			Flour from		
	Total	Wheat	Flour	United States	Canada	Australia	United States	Canada	Australia	United States	Canada	Australia
1921–22.....	10.50	2.17	8.33	9.30	.37	.83	2.03	.00	.14	7.27	.37	.69
1922–23.....	16.97	1.95	15.02	13.73	2.88	.36	1.11	.80	.04	12.62	2.08	.32
1923–24.....	50.51	20.21	30.30	32.87	11.95	5.69	8.30	7.40	4.51	24.57	4.55	1.18
1924–25.....	5.66	.57	5.09	3.29	1.72	.65	.37	.20	.00	2.92	1.52	.65
1925–26.....	19.91	8.12	11.79	5.29	13.72	.90	.00	7.69	.43	5.29	6.03	.47
1926–27.....	12.93	3.94	8.99	5.76	6.96	.21	.00	3.94	.00	5.76	3.02	.21

* Data from official trade statistics of the three exporting countries.

TABLE XIX C.—EXPORTS OF WHEAT AND FLOUR AS WHEAT TO THE WEST INDIES FROM NORTH AMERICA, AND TO BRAZIL FROM NORTH AMERICA AND ARGENTINA, ANNUALLY FROM 1922–23*

(Million bushels)

Year July–June	To West Indies[a]			To Brazil					
	Total	United States	Canada	Total	Wheat	Flour	United States[b]	Canada[b]	Argentina[b]
1922–23.....	12.85	8.66	4.19	18.38	13.63	4.75	2.24	.11	16.03
1923–24.....	14.40	9.76	4.64	21.93	15.53	6.40	2.49	.34	19.10
1924–25.....	12.65	9.23	3.57	20.50	13.16	7.34	3.24	.15	17.11
1925–26.....	12.77	8.24	4.53	21.93	13.51	8.42	4.06	.99	16.88
1926–27.....	13.10	9.19	3.91	24.95	15.91	9.04	4.25	1.20	19.50

* Data from official trade statistics of the three exporting countries.

[a] Flour only—wheat exports to the West Indies from these two countries never amounted to more than 150 thousand bushels during this period.

[b] Wheat and flour.

TABLE XX.—UNITED STATES WHEAT AND FLOUR EXPORTS, ANNUALLY FROM 1920–21*

(Thousand bushels)

Crop year July–June	Wheat inspected for export						Unclassified wheat	Total wheat exports	Flour as wheat	Total exports	Total imports (less re-exports)	Net exports
	Hard red spring	Durum[a]	Hard red winter	Soft red winter	White (Pacific)	Mixed[b]						
1920–21.....	10,081	4,872	132,701	34,281	27,729	68,615	14,989	293,268	76,046	369,314	56,404	312,910
1921–22.....	20,145	8,697	78,477	18,998	43,652	18,963	19,389	208,321	74,245	282,566	16,852	265,714
1922–23.....	8,718	12,271	51,654	20,846	13,602	25,047	22,813	154,951	69,949	224,900	19,735	205,165
1923–24.....	1,022	4,908	19,640	9,810	18,653	5,435	19,325	78,793	81,087	159,880	27,954	131,926
1924–25.....	16,760	5,945	90,840	6,944	10,063	9,386	55,552	195,490	65,313	260,803	6,106	254,697
1925–26.....	3,338	4,170	7,358	2,282	16,914	5,944	23,183	63,189	44,846	108,035	15,363	92,672
1926–27.....	1,829	611	66,874	29,980	26,615	1,398	28,943	156,250	62,910	219,160	13,164	205,996

* Data of U.S. Departments of Agriculture and Commerce. See especially *Agriculture Yearbooks, 1924*, p. 579, and *1926*, p. 816; and *Crops and Markets* for 1926–27 data.

[a] Durum exports are materially understated, in earlier years chiefly as explained in note *b*, in later years chiefly because inspections for export are limited to Atlantic, gulf, and Pacific ports, so that large quantities of durum wheat that are exported from lake ports via Montreal escape classification.

[b] It was estimated that 20,030,000 bushels of durum were mixed with spring wheat in 1920–21. Other mixed wheat exports in 1920–21 were largely soft and hard winter wheat shipped through gulf ports. In 1921–22 and 1922–23, 70 per cent of the exports of mixed wheat is estimated as durum. See *Agriculture Yearbook, 1924*, p. 578.

TABLE XXI.—INTERNATIONAL TRADE IN WHEAT AND FLOUR, MONTHLY FROM JULY 1926*

(Million bushels)

A.—NET EXPORTS

Month	United States	Canada	India	Australia	Argentina	Chile	Hungary	Jugo-Slavia	Poland	Algeria	Tunis	Egypt
July.....	19.0	20.7	2.30	2.8	4.5	.08	.81	.40	.15	.44	.46	(.87)[a]
Aug.....	34.8	11.6	1.18[b]	2.2	2.6	.02[b]	3.50	1.45	.28	.43	.26	(.68)[a]
Sept.....	29.6	13.2	.46[b]	1.6	2.1	.02[b]	3.54	2.27	.06	.68	.34	(.84)[a]
Oct.....	22.3	34.9	.77	1.5	1.8	.00[c]	3.75	1.79	(.03)[a]	.11	.29	(.78)[a]
Nov.....	18.1	49.6	.93[b]	1.5	1.4	.05[b]	2.50	1.43	.03	.17	.24	(.70)[a]
Dec.....	13.2	48.8	.50[b]	6.0	2.1	...	1.95	.74	(.10)[a]	(.11)[a]	.09	(.67)[a]
Jan.....	12.0	16.0	.64[b]	15.2	15.2	...	1.05	.32	(.27)[a]	(.32)[a]	(.01)[a]	(.70)[a]
Feb.....	8.0	14.8	(.18)[a]	14.2	25.2	.04	.75	.16	(.38)[a]	(.45)[a]	(.14)[a]	(.81)[a]
Mar.....	9.1	21.0	.27[b]	15.9	27.0	.06[b]	.77	.43	(.75)[a]	(.50)[a]	(.08)[a]	(.58)[a]
Apr.....	15.2	22.0	.37[b]	12.4	24.0	.03[b]	.67	.37	(1.66)[a]	(.47)[a]	(.18)[a]	(.77)[a]
May.....	13.5	32.3	.35[b]	13.2	18.7	.04[b]	1.29	.45	(2.49)[a]	(.55)[a]	(.25)[a]	(1.05)[a]
June.....	11.0	19.6	2.88	10.9	13.1	...	.95	.27	(2.34)[a]	(.34)[a]	(.16)[a]	(.70)[a]
July.....	11.6	8.8	5.12[b]	8.1	9.9	...	1.26	.06	(.42)[a]	(.26)[a]	(.10)[a]	(.47)[a]

B.—NET IMPORTS

Month	Irish Free St.	United Kingdom	France[d]	Germany	Belgium	Italy	Netherlands	Scandinavia	Switzerland	Czecho-Slovakia	Baltic States[e]	Japan
July.....	1.55	18.65	1.02	12.04	3.89	8.14	2.09	1.22	2.33	2.79	.71	.01
Aug.....	1.50	20.98	2.80	13.59	3.51	3.60	2.26	1.37	1.66	.78	.64	.93[b]
Sept.....	1.49	17.48	2.62	5.46	2.78	3.30	3.90	1.48	1.62	2.13	.72	.81[b]
Oct.....	1.47	14.62	1.99	6.92	2.42	3.46	2.02	1.82	2.10	1.93	.71	1.47
Nov.....	1.57	14.82	1.39	5.97	2.76	6.70	2.34	1.64	1.53	1.86	1.02	1.12[b]
Dec.....	1.72	16.71	3.02	5.28	2.88	6.68	1.98	1.45	1.03	2.34	.74	1.43[b]
Jan.....	1.16	17.35	7.31	4.76	2.98	8.23	2.03	1.48	.81	.77	.55	1.80[b]
Feb.....	1.60	15.81	7.89	4.66	3.31	9.41	2.07	1.17	1.38	1.26	.38	1.31
Mar.....	1.83	19.90	7.23	5.66	3.83	11.41	2.31	1.36	1.56	1.53	.51	1.97[b]
Apr.....	1.72	18.89	4.61	8.44	3.90	8.83	2.18	1.21	1.08	1.23	.44	1.51[b]
May.....	1.98	19.06	6.54	10.19	3.51	9.73	2.87	2.05	1.00	1.72	.70	1.78[b]
June.....	1.99	24.28	6.58	10.65	4.00	7.62	2.43	2.48	1.11	2.98	.72	2.81
July.....	1.70	17.33	10.00	10.19	3.62	7.59	2.02	2.06	1.43	1.56	.63	1.16[b]

* Data from official sources and International Institute of Agriculture. Totals of the above monthly figures do not always check exactly with yearly figures printed elsewhere, owing to the fact that the yearly figures presumably contain revisions not available by months. Dots (....) indicate that data are not available.

[a] Net import.
[b] Gross, not net.
[c] Net import of 1,200 bushels.
[d] Probably understatements.
[e] Finland, Esthonia, Latvia.

TABLE XXII.—OCEAN FREIGHT RATES ON WHEAT AND CORN, 1913 AND CROP YEARS 1921–22 TO 1926–27*

(Cents per bushel)

Period	Canada to United Kingdom	New York to Liverpool	Northern Range to United Kingdom	Northern Range to Genoa	Northern Pacific to United Kingdom	La Plata down river to United Kingdom	Karachi to United Kingdom	Australia to United Kingdom
1913 (Jan.–Dec.)	8.3	5.8	8.0	11.9	25.7	10.6	12.2	20.4
1921–22 (Aug.–July)	10.7	8.5	10.3	12.5	25.3	14.6	12.8	28.6
1922–23 (Aug.–July)	9.2	5.5	8.0	11.0	22.2	14.3	15.4	23.6
1923–24 (Aug.–July)	9.4	6.8	8.6	10.4	21.2	13.7	15.0	21.8
1924–25 (Aug.–July)	9.4	6.3	8.8	10.5	21.3	12.0	14.7	25.2
1925–26 (Aug.–July)	9.0	7.0	8.0	9.2	20.0	10.9	13.1	22.3
1926–27 (Aug.–July)	12.0	9.7	12.1	13.3	23.9	19.9	15.8	28.5
1926 July	10.6	6.1	9.9[a]	n.q.	19.8	16.6	12.8	25.5[a]
Aug.	10.8	7.4	10.6[b]	n.q.	19.7	16.4	12.4	26.4
Sept.	13.6	9.9	11.9	13.6[b]	22.0	17.6	12.9	26.3
Oct.	20.2	17.3	18.5	20.6	26.5	26.1	16.1[a]	29.2
Nov.	23.1	22.0	21.2	19.2[a]	29.8	30.8	20.7	34.1
Dec.	13.6	13.2	12.5	13.1	27.4	24.7	18.8	33.7
1927 Jan.	9.1	8.7	11.4	12.3	24.8	20.6	17.9	30.7
Feb.	8.9	7.8	8.9	11.6	23.9	19.6	18.2	31.4
Mar.	8.3	6.4	7.2	11.6	24.3	18.2	17.9	30.6
Apr.	9.9	6.4	8.0	11.4	23.8	17.8	15.7	25.9
May	9.9	6.4	8.9	11.4	21.2	18.4	14.5	25.3
June	8.0	5.7	n.q.	9.9	21.6	15.9	13.8	26.3
July	7.6	4.6	n.q.	8.6[b]	21.0	12.5	12.2	23.1

* Averages of Friday rates published in *International Crop Report and Agricultural Statistics*. New York–Liverpool rates are for parcels in liners; others for cargoes.

[a] Three-week average. [b] One week.

TABLE XXIII.—WHEAT STOCKS IN THE UNITED STATES AND CANADA, 1920–27*

(Thousand bushels)

Year	United States (July 1)				Canada (August 31, 1920–23; July 31, 1924–27)				
	Total	On farms	In country mills and elevators	Commercial visible (Bradstreet's)	Total	On farms	In elevators	In transit	In flour mills
1920	110,254	49,546	37,304	23,404	.....[a]	2,122	6,930	.....[a]	238
1921	93,840	56,707	27,167	9,966	13,727	2,144	4,831	6,032	720
1922	81,457	32,359	28,756	20,342	20,590	2,360	11,024	4,578	2,628
1923	102,414	35,894	37,117	29,403	11,690	1,441	5,051	2,758	2,440
1924	106,204	30,981	36,626	38,597	45,159[b]	7,363[c]	27,400[b]	5,856[b]	4,539[b]
1925	86,447	29,357	25,287	31,803	26,483	2,709	17,939	3,835	2,000
1926	65,949	20,973	28,490[d]	16,486	35,601	3,987	25,451	3,163	3,000
1927	74,950	27,359	22,075[d]	25,516	50,586	4,264	37,079	5,243	4,000
Average									
1910–14	89,411	32,485	31,600	25,326	.....[a]	.....[a]	.....[a]	.....[a]	.....[a]
1921–25	94,073	37,060	30,991	26,022					

* Bradstreet's visible, and official data of U.S. Department of Agriculture and Dominion Bureau of Statistics. See especially *Agriculture Yearbooks, Canada Yearbooks, Price Current-Grain Reporter*, and press releases. The Canadian stocks figures do not check with the official statements of Canadian carryovers, as given in the table of approximate disposition of wheat supplies in Canada (Appendix Table XXXII), presumably because the carryover figures exclude part of the wheat in transit figures, included above.

[a] Not available.

[b] July 31, as for later years.

[c] For 1924 quantities in farmers' hands relate to August 31; for subsequent years to July 31.

[d] Estimates for 1926 and 1927 on new basis, not entirely comparable with figures for earlier years, which are probably too low.

TABLE XXIV.—UNITED STATES CENSUS REPORTS ON CITY MILL STOCKS OF WHEAT AND FLOUR, 1925-27*

(Million bushels)

Item	June 30 1925	Dec. 31 1925	Mar. 31 1926	June 30 1926	Sept. 30 1926	Dec. 31 1926	Mar. 31 1927	June 30 1927
Percentage of U.S. flour output represented	87.4[a]	88.0[a]	88.4[a]	87.4[a]	87.4[a]	87.5[a]	90.5[b]	90.1[b]
Wheat stocks:								
In country elevators	2.16	7.55	4.67	2.52	8.92	8.47	6.06	2.56
In public terminal elevators	3.44	12.70	7.10	3.00	12.04	11.95	6.85	3.88
In private terminal elevators not attached to mills	26.72	82.86	3.65	1.14	8.57	10.66	5.84	1.61
In transit			3.29	6.73	15.38	13.49	6.45	10.39
In mills and elevators attached to mills			45.93	22.45	79.87	71.84	60.57	34.15
Total	32.31	103.11	64.64	35.83	124.77	116.41	85.77	52.59
Wheat-flour stocks in wheat equivalent (4.7 bu. = 1 bbl.)	15.73	21.55	18.28	14.67	19.82	20.38	19.40	16.76
Total wheat and flour as wheat	48.04	124.66	82.92	50.50	144.59	136.79	105.17	69.35

* Data from press releases of U.S. Department of Commerce.

[a] Based on total output (114,438,544 barrels) of wheat flour reported at the census of manufactures, 1923.

[b] Based on total output (114,689,930 barrels) of wheat flour reported at the census of manufactures, 1925.

TABLE XXV.—FLOUR STOCKS IN THE UNITED STATES, MONTHLY FROM JULY 1920*

(Thousand barrels)

Crop year	July 1	Aug. 1	Sept. 1	Oct. 1	Nov. 1	Dec. 1	Jan. 1	Feb. 1	Mar. 1	Apr. 1	May 1	June 1	July 1
1920–21	2,283	1,927	1,790	2,153	2,450	2,310	2,170	2,093	2,126	1,977	1,863	1,649	1,478
1921–22	1,478	1,710	1,993	2,213	2,625	2,544	2,024	1,979	1,758	1,752	1,914	1,856	1,658
1922–23	1,658	1,865	1,986	2,246	2,388	2,157	2,293	2,347	2,152	2,110	2,355	2,173	2,233
1923–24	2,233	2,382	2,271	2,533	2,599	2,491	2,406	2,184	2,193	2,186	2,305	2,029	2,046
1924–25	2,046	2,129	2,226	2,449	2,286	2,234	2,035	1,883	1,967	2,103	2,006	1,874	1,815
1925–26	1,815	1,855	1,988	2,212	2,378	2,425	1,993	1,975	1,922	1,971	2,237	2,055	2,076
1926–27	2,076	2,282	2,402	2,303	2,799	2,515	2,303	2,289	1,927	1,907	1,899	1,917	1,931

* As compiled by Howard, Bartels & Co. and published in the *Daily Trade Bulletin*, Chicago, and the *Daily Market Record*, Minneapolis. These "include supplies in leading cities and at country points, small mills, etc.," but exclude flour in transit and are otherwise far from comprehensive. *Russell's Commercial Review* gives another series, from 1921–22, which runs about three times as large. It includes flour on the piers in New York and an estimate for mill and transit stocks. This is not given here, because it overlaps the mill stocks, involves a large element of estimate, and covers a shorter period.

TABLE XXVI.—WORLD VISIBLE WHEAT SUPPLIES, AUGUST 1, 1920–27, AND MONTHLY, 1926–27*

(Million bushels)

Date	United States	Canada	Argentina	Australia	United Kingdom ports	Afloat to Europe	North America	Argentina, Australia	U.K. and afloat	Grand total	Total ex-Australia
1920 Aug. 1	42.7	8.2	3.7	27.5	12.8	76.2	50.9	31.2	89.0	171.1	143.6
1921 Aug. 1	56.2	8.9	3.7	30.0	7.6	57.9	65.1	33.7	65.5	164.3	134.3
1922 Aug. 1	43.1	19.3	2.2	3.0	7.1	48.9	62.4	5.2	56.0	123.6	120.6
1923 Aug. 1	73.3	14.1	4.4	18.0	8.2	39.0	87.4	22.4	47.2	157.0	139.0
1924 Aug. 1	72.1	31.6	6.8	30.0	9.9	41.8	103.7	36.8	51.7	192.2	162.2
1925 Aug. 1	57.3	23.4	7.7	8.4	9.2	33.3	80.7	16.1	42.5	139.3	130.9
1926 Aug. 1	64.2	28.3	4.1	6.2	4.3	38.6	92.5	10.3	42.9	145.7	139.5
Sept. 1	117.1	16.6	4.0	3.6	5.8	35.7	133.7	7.6	41.5	182.8	179.2
Oct. 1	135.1	43.4	4.5	1.4	5.4	35.4	178.5	5.9	40.8	225.2	223.8
Nov. 1	137.4	81.3	3.8	0.0	3.7	37.8	218.7	3.8	41.5	264.0	264.0
Dec. 1	133.0	123.0	1.8	2.0	3.6	36.9	256.0	3.8	40.5	300.3	298.3
1927 Jan. 1	123.7	123.4	2.6	81.0	4.7	43.2	247.1	83.6	47.9	378.6	297.6
Feb. 1	110.2	118.9	8.1	80.0	4.7	59.1	229.1	88.1	63.8	381.0	301.0
Mar. 1	104.3	116.7	14.7	64.0	4.2	70.1	221.0	78.7	74.3	374.0	310.0
Apr. 1	88.7	107.3	14.8	53.0	4.9	75.8	196.0	67.8	80.7	344.5	291.5
May 1	68.8	80.5	16.6	43.5	5.7	71.6	149.3	60.1	77.3	286.7	243.2
June 1	55.1	58.0	13.6	31.5	7.5	65.9	113.1	45.1	73.4	231.6	200.1
July 1	46.2	45.5	9.5	22.5	8.4	50.9	91.7	32.0	59.3	183.0	160.5
Aug. 1	65.9	42.7	6.3	12.7	7.8	46.1	108.6	19.0	53.9	181.5	168.8
Average, Aug. 1.											
1910–14	58.8	10.8	1.3	5.9[a]	15.4	35.2	69.6	7.2[a]	50.6	127.4[a]	121.5
1921–25	60.4	19.5	4.9	17.9	8.4	44.2	79.9	22.8	52.6	155.3	137.4

* A joint compilation by Broomhall, the *Daily Market Record,* Minneapolis, and the *Daily Trade Bulletin,* Chicago; here summarized from Broomhall's *Corn Trade News* and the *Daily Trade Bulletin.* Includes some flour stocks.

[a] For Australia, four-year average, 1911–14.

TABLE XXVII.—WHEAT GROUND, FLOUR PRODUCED, AND FLOUR EXPORTED, UNITED STATES, MONTHLY FROM JULY, 1925*

Month	Year ending June 30, 1926						Year ending June 30, 1927					
	Reported by 975 identical mills			Estimated total			Reported by 968 identical mills			Estimated total		
	Wheat ground *(thous. bushels)*	Flour produced *(thous. bbls.)*	Rate of extraction *(bu. per bbl.)*	Wheat ground *(thous. bushels)*	Flour produced *(thous. bbls.)*	Flour exports *(thous. bbls.)*	Wheat ground *(thous. bushels)*	Flour produced *(thous. bbls.)*	Rate of extraction *(bu. per bbl.)*	Wheat ground *(thous. bushels)*	Flour produced *(thous. bbls.)*	Flour exports *(thous. bbls.)*
July	40,287	8,763	4.60	46,249	9,806	777	43,676	9,513	4.59	48,860	10,485	793
Aug.	42,397	9,203	4.61	48,722	10,413	874	47,327	10,377	4.56	52,898	11,430	1,442
Sept.	45,466	9,827	4.63	52,281	11,126	800	48,905	10,754	4.55	54,654	11,835	1,560
Oct.	49,029	10,562	4.64	56,520	12,000	1,012	48,196	10,563	4.56	53,731	11,610	1,385
Nov.	41,681	8,971	4.65	48,097	10,190	872	43,155	9,453	4.57	49,350	10,368	1,344
Dec.	40,924	8,790	4.66	47,186	9,976	1,009	39,927	8,758	4.56	44,369	9,587	1,208
Jan.	39,691	8,535	4.65	44,939	9,521	676	38,676	8,478	4.56	42,869	9,263	1,009
Feb.	34,080	7,325	4.65	38,610	8,180	647	35,785	7,853	4.56	39,611	8,559	874
Mar.	37,035	8,074	4.59	42,248	9,068	695	39,928	8,739	4.57	44,196	9,527	867
Apr.	34,662	7,465	4.64	39,098	8,301	834	37,179	8,088	4.60	41,064	8,795	1,016
May	34,027	7,283	4.67	38,389	8,099	679	37,891	8,273	4.58	41,781	8,987	1,099
June	36,774	7,903	4.65	41,106	8,709	667	38,109	8,287	4.60	41,970	8,989	863
Total	476,053	102,701	4.64	543,445	115,389	9,542	498,754	109,136	4.57	555,353	119,435	13,460

* The first three columns for each year are from U.S. Department of Commerce press releases, October 6, 1926, and September 30, 1927, giving results of monthly milling census. Flour export data are from the *Monthly Summary of Foreign Commerce.* Fourth and fifth columns computed by a method to be discussed in a forthcoming issue of WHEAT STUDIES.

Table XXVIII.—Average Prices of Representative Wheats in Leading Exporting and Importing Markets, Monthly, 1926–27*

(U.S. dollars per bushel)

Month	United States				Canada		Liverpool							Argentina	Australia
	No. 2 Red Winter (St. Louis)	No. 2 Hard Winter (Kansas City)	No. 1 Dark Northern (Minneapolis)	No. 2 Amber Durum (Minneapolis)	No. 1 Manitoba (Winnipeg)	No. 3 Manitoba (Winnipeg)	No. 1 Manitoba	No. 3 Manitoba	No. 2 Hard Winter	Pacific White	South Russian	Australian	Argentine Rosafe	Barletta (Buenos Aires)	(Melbourne)
Aug.	1.34	1.31	1.56	1.53	1.51	1.38	1.72	1.62[a]	1.59	1.60	1.69[b]	1.73	n.q.	1.61	1.61
Sept.	1.36	1.32	1.48	1.38	1.44	1.33	1.67	1.57	1.54	1.56	1.61[c]	1.65	1.62[d]	1.60	1.61
Oct.	1.40	1.39	1.53	1.50	1.43	1.36	1.77	1.69	1.68	1.67	1.73[a]	1.72	1.68	1.64	1.61
Nov.	1.36	1.37	1.48	1.61	1.41	1.31	1.80	1.70	1.72	1.74	1.73	1.73	1.66	1.47	1.61
Dec.	1.37	1.38	1.48	1.74	1.33	1.23	1.71	1.63	1.67	1.67	1.66	1.67	1.56	1.36	1.30
Jan.	1.38	1.37	1.47	1.68	1.36	1.23	1.68	1.60	1.64	1.64	1.60	1.65	1.58	1.30	1.28
Feb.	1.35	1.35	1.46	1.60	1.40	1.27	1.72	1.61	1.61	1.64	1.63	1.62	1.58	1.31	1.24
Mar.	1.30	1.33	1.43	1.57	1.43	1.30	1.74	1.59	1.51[d]	1.62	1.62[d]	1.62[d]	1.54	1.32	1.23
Apr.	1.29	1.31	1.41	1.54	1.45	1.33	1.71	1.57	1.53	1.60	n.q.	1.61	1.52	1.33	1.25
May	1.42	1.42	1.53	1.58	1.56	1.46	1.80	1.60	1.61	1.69	n.q.	1.67	1.62	1.45	1.32
June	1.50	1.44	1.57	1.57	1.61	1.49	1.81	1.65[c]	1.65	1.67[c]	n.q.	1.71	1.67	1.47	1.35
July	1.41	1.36	1.58	1.53	1.62	1.53	1.79	1.67	1.58	1.59	n.q.	1.66	1.62	1.47	1.34

* United States prices are the U.S. Department of Agriculture monthly weighted averages of daily quotations for reported cash sales, compiled from *Crops and Markets*. Canadian prices are monthly averages of daily prices from the *Grain Trade News*. Liverpool and Argentine prices are averages of Friday quotations from *International Crop Report and Agricultural Statistics*, except Rosafé and No. 3 Manitoba at Liverpool which are averages of Tuesday quotations from Broomhall's *Corn Trade News*. Australian prices are averages of daily quotations for export wheat, furnished directly by an Australian correspondent. "n.q." signifies no quotation.

[a] Four-week average.
[b] Two-week average.
[c] One week only.
[d] Three-week average.

Table XXIX.—Monthly Prices of Domestic Wheat in Europe, from August 1924*

(U.S. dollars per bushel)

Month	Great Britain			France (Chartres)			Italy (Milan)			Germany (Berlin)		
	1924–25	1925–26	1926–27	1924–25	1925–26	1926–27	1924–25	1925–26	1926–27	1924–25	1925–26	1926–27
Aug.	1.54	1.53	1.76	1.50	1.62	1.61	1.40	1.88	1.85	1.29	1.55	1.75
Sept.	1.45	1.48	1.46	1.54	1.57	1.77	1.49	1.94	2.03	1.46	1.38	1.71
Oct.	1.52	1.34	1.48	1.62	1.48	1.88	1.77	1.94	2.21	1.47	1.37	1.72
Nov.	1.56	1.45	1.62	1.71	1.37	1.96	1.83	1.99	2.20	1.37	1.49	1.78
Dec.	1.54	1.60	1.55	1.77	1.33	1.78	1.94	2.12	2.31	1.44	1.62	1.74
Jan.	1.66	1.60	1.55	1.87	1.39	1.88	2.21	2.17	2.13	1.64	1.61	1.72
Feb.	1.74	1.54	1.54	1.89	1.42	1.81	2.31	2.16	2.11	1.63	1.60	1.72
Mar.	1.70	1.51	1.52	1.87	1.39	1.70	2.09	2.14	2.11	1.63	1.66	1.73
Apr.	1.58	1.57	1.50	1.77	1.40	1.82	1.86	2.20	2.02	1.60	1.87	1.76
May	1.64	1.75	1.58	1.85	1.39	1.91	1.93	2.19	2.16	1.70	1.92[a]	1.92
June	1.67	1.77	1.65	1.75	1.52	1.88	1.80	2.20	1.99	1.73	n.q.	1.96[b]
July	1.55	1.84	1.64	1.64	1.53	1.81	1.63	1.98	1.80	1.74	n.q.	n.q.

* Data for Great Britain are averages of weekly average *Gazette* prices as given in the *Economist;* for France, averages of Saturday prices furnished directly by Federal Reserve Board; for Italy, averages of Friday prices of soft wheat as given in *International Crop Report and Agricultural Statistics;* for Germany, monthly average prices as given in *Wirtschaft und Statistik*. All data are converted, for convenience, from the domestic currency in which they are quoted in the above sources into U.S. money by monthly average exchange rates. "n.q." indicates that no quotation was given.

[a] First half of May.
[b] First half of June.

TABLE XXX.—AVERAGE DAILY VOLUME OF TRADING IN WHEAT FUTURES IN UNITED STATES MARKETS, MONTHLY FROM JANUARY 1921*

(Million bushels)

Year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Year
1920–21	....	....	....	....	....	....	39.1	44.1	39.5	52.5	46.1	49.8	45.2[a]
1921–22	45.5	39.6	57.1	54.0	53.7	43.3	36.5	67.9	61.3	48.9	37.4	41.8	48.7
1922–23	34.4	36.2	33.5	32.5	37.6	42.1	36.6	37.0	27.9	48.0	41.0	40.9	37.3
1923–24	32.3	31.4	28.3	30.2	27.1	21.1	14.3	18.1	22.8	18.0	14.4	34.0	24.3
1924–25	53.3	50.0	42.7	61.4	60.9	58.8	73.4	81.0	87.4	59.3	60.3	67.6	62.9
1925–26	56.2	60.0	59.0	60.4	65.2	90.3	60.6	58.3	69.0	55.8	48.8	46.3	60.9
1926–27	57.5	47.1	46.2	43.6	53.3	37.4	28.2	26.4	34.1	33.8	50.4	44.8	41.9

* Data of Grain Futures Administration, U.S. Department of Agriculture. Not compiled prior to January 1921.
[a] Six-month average.

TABLE XXXI.—APPARENT DOMESTIC UTILIZATION OF WHEAT (CARRYOVERS DISREGARDED), ANNUALLY FROM 1920–21*

(Million bushels)

Crop year August–July	United States	Canada	India	Australia[a]	Argentina[a]	Chile[a]	Hungary	Bulgaria	Jugo-Slavia	Roumania	Morocco[a]
1920–21	525.1	97.4	362.8	29.4	90.2	21.0	37.9	28.2	39.2	59.9	17.9
1921–22	563.1	115.5	264.2	44.0	45.4	23.6	43.3	24.7	47.9	75.0	22.9
1922–23	667.8	120.8	338.4	46.5	55.4	24.4	49.6	28.3	43.5	90.4	12.2
1923–24	670.0	128.1	352.3	42.7	77.6	20.9	50.9	26.7	55.2	93.1	19.9
1924–25	608.0	70.0	322.5	44.4	73.9	19.3	38.0	26.4	48.2	67.2	27.0
1925–26	573.0	87.3	323.0	39.3	108.9	25.6	51.9	45.3	67.1	94.8	23.1
1926–27	634.2	117.1	310.8	....	.....	....	52.9	38.9[b]	61.7	99.1[b]	15.4
Average											
1909–14	580.1	101.5	302.1	35.9[a]	63.4[a]	19.0[a]	....	....	....	....	16.7[a]
1921–26	616.4	104.3	320.1	43.4[a]	72.2[a]	22.8[a]	46.7	30.3	52.4	84.1	21.0[a]

Crop year August–July	Algeria	Tunis	Egypt	British Isles	France	Germany	Italy	Belgium	Netherlands	Denmark	Norway	Sweden
1920–21	21.8	6.5	42.9	256.9	305.2	142.4[c]	240.7	42.4	24.9	7.7	4.9	16.9
1921–22	24.3	7.7	43.8	282.0	340.6	177.3[c]	294.6	55.0	28.3	15.2	6.1	16.2
1922–23	21.2	4.4	44.3	275.5	288.9	109.4[c]	277.3	50.3[d]	30.0	15.5	7.5	18.3
1923–24	28.6	7.1	49.2	298.1	328.9	137.2[c]	294.7	53.7[d]	33.0	18.1	6.7	23.4
1924–25	17.6	5.0	44.1	281.8	339.7	170.1[c]	258.8	52.4[d]	31.5	12.4	6.1	17.4
1925–26	28.1	9.1	49.0	263.6	341.1	175.6	308.6	54.2[d]	32.9	15.8	7.2	19.5
1926–27	25.2	12.7	46.0	289.1	293.7	187.2	307.2	52.9[d]	34.0	16.1	6.8	18.5
Average												
1909–14	29.8	7.0	33.7	277.3	361.2[e]	219.9[e]	236.3[e]	65.4	27.6	11.8[e]	4.1	15.2
1921–26	24.0	6.7	46.1	280.2	327.8	153.9	286.8	53.2	31.1	15.4	6.7	18.9

Crop year August–July	Spain	Portugal	Switzerland	Austria	Czecho-Slovakia	Poland	Finland	Latvia	Esthonia	Greece	Japan
1920–21	158.4	16.9[b]	16.5	20.0	44.7	....	2.7	.97	....	21.8	35.9
1921–22	153.1	17.4[b]	17.0	25.5	50.2	38.6	4.0	1.53	....	23.4	53.4
1922–23	125.3	16.5[b]	19.1	20.8	43.9	44.9	5.8	2.06	....	26.5	43.8
1923–24	156.8	16.4[b]	20.9	27.0	57.4	52.4	5.8	3.44	1.70	27.6	55.7
1924–25	122.6	14.5[b]	17.0	23.2	53.8	49.6	5.3	3.52	1.40	29.1	39.2
1925–26	161.9	15.5[b]	19.1	25.4	61.0	53.2	6.2	3.72	1.76	35.0[c]	52.2
1926–27	146.6[b]	15.0[b]	20.3	26.2[b]	54.2	55.2	6.1	3.53	1.74	31.2[c]	57.4
Average											
1909–14	136.6	....	20.2	71.6[c]	....	....	....	....	....	....	29.2
1921–26	143.9	16.4[b]	18.6	24.4	53.3	47.7	5.4	2.85	1.62[f]	28.3	48.9

* Computed from production and trade data given in Tables III and XVII. Dots (....) indicate that comparable production or trade figures are not available.

[a] For Southern Hemisphere and Morocco, calendar years 1921 and following, instead of crop years; averages are for calendar years—for Southern Hemisphere 1910–14 and 1922–26, for Morocco 1909–13 and 1921–25.

[b] Trade figures partially estimated.

[c] These figures are too low, as crops in post-war years are underestimated and net imports, at least to 1924–25, are incomplete. See WHEAT STUDIES, December 1924, I, 17–18.

[d] Luxemburg included with Belgium after May 1922.

[e] Pre-war boundaries.

[f] Three-year average.

TABLE XXXII.—APPROXIMATE DISPOSITION OF WHEAT SUPPLIES IN FOUR LEADING EXPORTING COUNTRIES, 1922–23 TO 1926–27*

(Million bushels)

Item	United States (July–June)					Canada (August–July)				
	1922–23	1923–24	1924–25	1925–26	1926–27	1922–23	1923–24	1924–25	1925–26	1926–27
Initial stocks	130	153	167	136	111	36	29	41	26	35
New crop	868	797	864	676	833	400	474	262	411	410
Total supplies	998	950	1,031	812	944	436	503	303	437	445
Net exports	208	135	258	95	209	279	346	192	324	293
Seed requirements	91	79	88	83	85	40	39	39	40	39
Consumed for food	470	477	479	492	492	41	42	42	42	44
Unmerchantable and lost in cleaning	76	92	70	31	20	22	31	22	18	31
Fed on farms						10	15	5	5	10
Apparent error in crop estimate						+15	—11	—23	—27	—20
Stocks at end	153	167	136	111	138	29	41	26	35	48
Total disappearance	998	950	1,031	812	944	436	503	303	437	445

Item	Argentina (August–July)					Australia (August–July)				
	1922–23	1923–24	1924–25	1925–26	1926–27	1922–23	1923–24	1924–25	1925–26	1926–27
Initial stocks	66	56	63	57	67	27	42	38	36	30
New crop	196	248	191	191	221	109	125	165	115	161
Total supplies	262	304	254	248	288	136	167	203	151	191
Net exports	139	172	123	94	143	50	86	124	77	103
Seed requirements	19	21	23	25	24	11	10	11	11	12
Consumed for food	44	45	49	54	55	28	28	29	29	30
Feed and waste	4	3	2	8	5	5	5	3	4	5
Stocks at end	56	63	57	67	61	42	38	36	30	41
Total disappearance	262	304	254	248	288	136	167	203	151	191

* Based so far as possible upon official estimates for the various items of supply and disposition. It is necessary, however, to supply estimates for certain items in all four countries, as well as to adjust official figures in order to place all data on the designated crop year basis. The following notes explain our methods of estimation and adjustment.

UNITED STATES. *Initial stocks.* The figure for 1926–27 (like the figure for stocks at the end of 1926–27) is the sum of official estimates of stocks on farms and of stocks in country mills and elevators, Bradstreet's figure for visible supplies, and wheat and flour stocks in city mills as reported by the Census Bureau. Flour stocks converted at 4.7 bushels per barrel. In order to avoid duplication with stocks in country mills and visibles, the quantities of wheat reported in "country elevators" and "in public terminal elevators" have been subtracted from the Census Bureau's totals. Published figures for country mill and elevator stocks on and prior to July 1, 1925, have been raised by 29 per cent, in accord with the Department of Agriculture's revision of the original estimate for July 1, 1926. In the absence of official data, city mill stocks on and prior to July 1, 1924, have been estimated roughly at 40 million bushels in 1922 and 1923, and 50 million in 1924. These figures appear reasonable in the light of official estimates for later years. A higher figure for July 1, 1924, than for any other year except 1927, seems acceptable in view of special incentives for mills to accumulate stocks in that year. *New crop.* Official figures. *Net exports.* Official data for domestic exports, plus exports, less imports. Includes shipments to possessions. Flour exports and re-exports converted at 4.7 bushels per barrel; flour imports (almost entirely from Canada) at the official Canadian figure, 4.5 bushels per barrel. *Seed requirements.* Official data. *Consumed for food.* Estimated directly on the basis of population estimates, assumed per capita consumption of flour of .9 barrel, and official data on milling ratios raised 1.5 per cent to account for small mills not reporting to the Census Bureau. *Unmerchantable and lost in cleaning; fed on farms; apparent error in crop estimate.* In the absence of official data on any of these items, the three must be bracketed and calculated as a residual. In our judgment the composite item so calculated is of reasonable size for 1922–23 to 1924–25, though perhaps slightly too high in each of these years. The low figures for 1925–26 and 1926–27 establish the presumption that the crops were officially underestimated in these two years; but numerical expression of the probable underestimates is not feasible in the absence of any dependable method of estimating the quantities of wheat fed and wasted annually. *Stocks at end.* See *Initial stocks.*

CANADA. *Initial stocks.* Official data after August 1, 1924. The figures are slightly lower than official estimates of carryovers as shown in Appendix Table XXIII, apparently because certain quantities of wheat in transit are excluded from the former. Figures for August 1, 1922 and 1923, obtained by adding to official stocks figures as of September 1 the net exports and domestic consumption in August. *New crop.* Official data. *Net exports.* Official data. *Seed requirements.* Official data. *Consumed for food.* Official data except for 1926–27, which is estimated on the basis of increased popula-

tion and a high milling ratio of 4.54 bushels per barrel. *Unmerchantable and lost in cleaning.* Official data. *Fed on farms.* Rough approximation, based on the assumption that only small quantities of wheat are fed on farms except when prices are very low or much grain is damaged. *Apparent error in crop estimate.* Calculated as a residual. The figures may be regarded as fairly reliable indicators in view of the completeness of official disposition figures, except in so far as our estimates of wheat fed on farms are erroneous. *Stocks at end.* See *Initial stocks.*

ARGENTINA. *Initial stocks.* All stocks figures are calculated as residuals, since direct estimates of stocks are not made in Argentina. Our figures, as of August 1, in all years except 1927 check approximately with the sum of reported exports from August 1 to December 31 and 5/12 of annual domestic consumption for food and feed as estimated otherwise. The lack of information regarding stocks of old-crop wheat on January 1 each year precludes a more precise check; but, except in 1927, when a considerable amount of poor quality wheat from the crop of 1925 was carried over for mixing purposes, negligible January 1 stocks may be assumed as normal. *New crop.* Official data. *Net exports.* Official data. *Seed requirements.* Based on official data for acreage sown and average seed requirements per acre. The figure for 1925–26 has been made unusually high to allow for increased per acre requirements due to poor quality of seed. *Consumed for food.* Based on official data on flour milled less flour exported in calendar years, adjusted to present data for crop years. The figure for 1926–27 contains a considerable element of estimate, since data for the calendar year 1927 are not available. *Feed and waste.* Rough approximations based on the assumption that feed use of wheat is normally very small in a country exporting large quantities of corn, and introduced chiefly because relatively large quantities were probably fed and wasted in the calendar year 1926, following a crop of poor quality. *Stocks at end.* See *Initial stocks.*

AUSTRALIA. *Initial stocks.* Calculated as residuals, on essentially the same assumptions as governed calculations of Argentine stocks. The resulting figures check closely with figures obtained by assuming January 1 stocks of old-crop wheat constant at 5 million bushels, and adding to these figures (1) exports August 1 to December 31, less probable exports of new-crop wheat in December, and (2) 5/12 of annual domestic consumption for food and feed. *New crop.* Official data. *Net exports.* Official data. *Seed requirements.* Chiefly official data, but 1925–26 and 1926–27 figures are partially estimated. These figures include wheat sown for hay as well as for grain. *Consumed for food.* Based on official monthly data on flour production, less exports of flour. Figure for 1926–27 partially estimated. *Feed and waste.* Based on official estimate of .5 to 1 bushel per capita utilization of wheat for feed, waste, and seed for green forage. *Stocks at end.* See *Initial stocks.*

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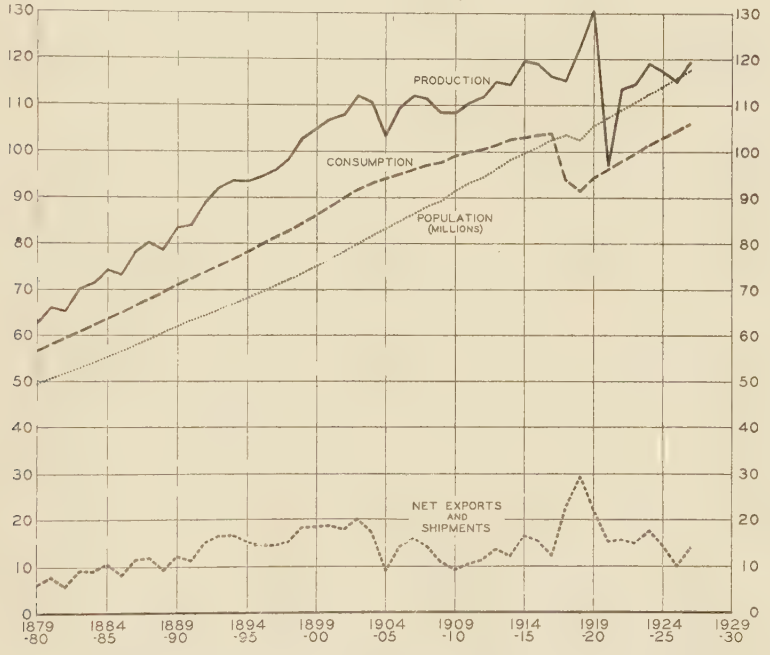
VOL. IV, NO. 2 DECEMBER 1927

STATISTICS OF AMERICAN WHEAT MILLING AND FLOUR DISPOSITION SINCE 1879

FLOUR PRODUCTION AND DISPOSITION, 1879–80 TO 1926–27

(Million barrels)



Flour consumption in the United States increased in direct proportion to the increase in population up to about 1903, but somewhat more slowly between 1903 and 1917. After the entry of the United States into the war, annual flour consumption was reduced over 10 per cent. Since 1918 per capita consumption has remained practically constant at about nine-tenths of a barrel. Total annual output has followed the same general trend as domestic consumption, but has varied considerably from year to year, influenced by export demand and changes in flour stocks.

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STANFORD UNIVERSITY, CALIFORNIA

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Carl Lucas Alsberg — Joseph Stancliffe Davis

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The Food Research Institute was established at Stanford University in 1921 jointly by the Carnegie Corporation of New York and the Trustees of Leland Stanford Junior University, for research in the production, distribution, and consumption of food.

STATISTICS OF AMERICAN WHEAT MILLING AND FLOUR DISPOSITION SINCE 1879

I. SUMMARY

The publication of greatly improved statistics of American flour output and wheat grindings in recent years has emphasized the need for similar statistics covering earlier years. On investigating the possibility of preparing estimates to supply this need, we have found that such estimates may be derived with practically the same accuracy as is shown by most of the more recent statistics. In addition, we find that the current estimates of monthly flour output, based on incomplete reports, contain appreciable errors, and we have accordingly prepared revised estimates in which the major errors are removed.

The principal results of the present study are embodied in tables and charts showing: (1) for each crop year since 1879–80 the approximate flour output of the mills of the United States, the quantities of wheat ground and millfeed produced, and the domestic consumption of flour; (2) revised estimates of the monthly flour output of the mills of the United States since May 1923; and (3) estimates showing, in terms of deviations from a 4-year average, the approximate total stocks of flour in all positions (including retail and household stocks) in the United States on the first of each month since May 1, 1923. These are all brought together, with related data, in Appendix Tables I and II, and are shown graphically in a series of charts running through the text.

Several incidental conclusions seem to be worthy of special mention. It appears that the severe decline in consumption of flour per capita in the United States, amounting to over 20 per cent since 1904, took place in two stages: a steady decline of about 11 per cent between 1904 and 1917, and a further decline of about 10 per cent during the last six months of 1917. Since 1918 the rate of consumption has been practically constant at about nine-tenths of a barrel per capita. The war-time curtailment of flour consumption was apparently facilitated by the fact that it involved dietary changes in line with previous tendencies. A continuation of the pre-war trend without any interruption would have brought the rate of consumption down to its present level at about the end of 1927.

The total quantity of wheat milled is found to vary from year to year considerably more than the total flour output, owing to variations in the amount of wheat required per barrel of flour. The latter is found to depend very closely on the average weight per bushel of the wheat crop of the country. It is important to take account of these variations in wheat requirements per barrel of flour in calculating the disposition of wheat in the United States from year to year.

In connection with the study of flour stocks it is found that the existing compilations of reports of stocks give no significant indication of the amount of change in total flour stocks or even of the time or direction of the changes in the total. The changes in total stocks between corresponding dates in successive years are found to be so large as appreciably to affect calculations of flour consumption, and the varying attitude of handlers and users of flour toward the accumulation of stocks is shown to be a major cause of variations in milling activity.

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Estimates of Annual Flour Production

A complete presentation of the basis for the estimates here given requires a somewhat lengthy and technical discussion involving consideration of a multitude of details. The broader outlines of the method, however, together with the principles involved, may be indicated quite briefly.

The only statistics of flour production which may be regarded as substantially complete are those obtained in the censuses of manufactures and the statistics compiled by the Food Administration Grain Corporation and its successor, the United States Grain Corporation, between July 1918 and May 1920. The census statistics are available only in the form of totals for calendar years: every ten years up to 1899, every five years from 1899 to 1919, and every two years since 1919. The Grain Corporation figures are given weekly and monthly through the nearly two years during which they appear to include 99 per cent of the total United States output. Even the census statistics, however, are not all entirely complete, owing chiefly to the omission of custom mills in the quinquennial and the biennial censuses.

To fill in the gaps between the census years and to put all the data on a crop-year basis, which is more useful for most purposes, either of two methods may be employed. One method is to attempt to raise certain incomplete figures to 100 per cent of the total. Such incomplete figures are available in compilations made by the *Northwestern Miller,* over a long period, and more recently by the Grain Corporation and the Department of Commerce. These give weekly or monthly statistics of the output of a portion of the mills of the country representing in the aggregate a fraction of the total ranging from about 30 to about 90 per cent.[1] By devising methods of raising these partial figures to 100 per cent, it is possible to approximate the monthly total flour production over a long period, and from the monthly figures to compute crop-year totals.

The estimates thus obtained are subject to considerable error. To raise the partial figures to 100 per cent, it is necessary to estimate the percentage of the total represented in the available figures. For census years the percentage is readily calculated, but applying the percentage thus obtained to calculations for intercensal years involves the assumption that the changes in the reported figures are accurately representative of the changes in the total. Our investigations indicate that even the recent Department of Commerce statistics, including about 90 per cent of the total production, do not reflect the changes in total production as accurately as might be desired.[2] Less complete statistics may be expected to reflect changes in the total even less accurately.

The second possible method of estimating annual flour production is made available by the fact that, except under such extraordinary conditions as arose during the war, actual consumption of flour, per capita, in the United States apparently changes very little from year to year, except with the gradual change in consumption habits.[3] Per capita consumption, therefore, follows very closely a trend which may be represented graphically by a smooth curve, and since a number of points on that curve can be located by calculation from the accurate consumption statistics available for census years, a curve can be drawn through these points which will represent very accurately the per capita consumption for any crop or calendar year within the period covered.

Given the per capita consumption of flour

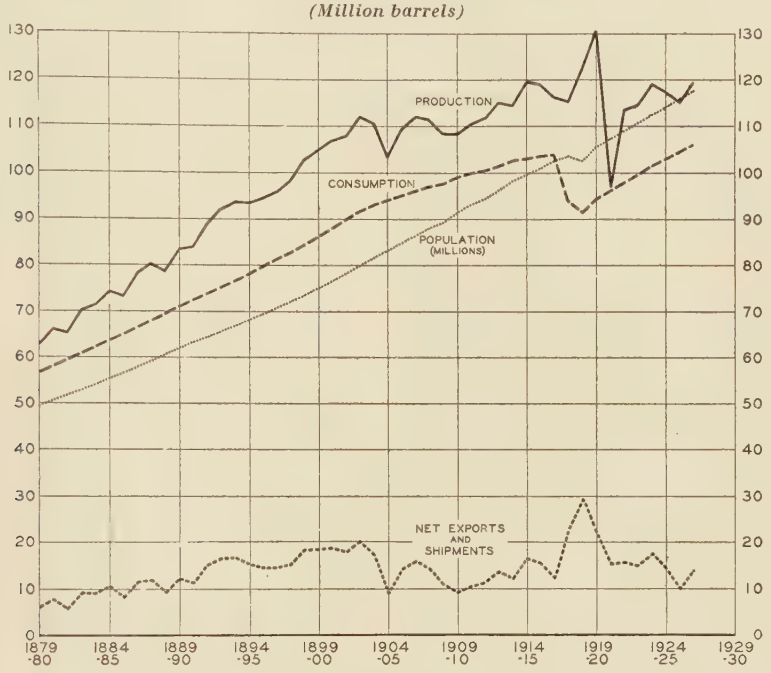
[1] As noted above, the Grain Corporation figures cover 99 per cent of the total over a part of the period.

[2] See below, p. 69.

[3] The statement that the only important changes in per capita consumption of flour in the United States, except under such extraordinary conditions as existed during the war, are the result of gradually changing habits of consumption and that consumption does not change appreciably with changes in the price of wheat, in the price of other foods, or in the volume of unemployment, is supported by a large amount of evidence. The best statistics available show only such changes in apparent per capita consumption of flour as would be expected from changes in consumption habits and the known defects of the statistics. The facts of common observation indicate great stability in flour consumption, and we know of no evidence indicating material changes in flour consumption from year to year, even among the poorest classes. When statistics of sufficient accuracy are available over a considerable period of years, we shall undoubtedly find evidence of some changes in per capita flour consumption other than those resting on changes in consumption habits, but it seems clear that these changes must be of an order of magnitude in the neighborhood of 1 per cent or less. As will be shown in later pages, this is less than the apparent probable error of the best statistics on flour consumption now available.

in each year, it is a simple matter to calculate the total domestic consumption. The total production in any period must obviously equal the domestic consumption plus the exports in the same period, neglecting differences in total stocks of flour at the beginning and at the end of the period.

Chart 1.—Flour Production and Disposition in the United States, by Crop Years, 1879–80 to 1926–27*



* Data in Appendix Table I. Domestic consumption of flour increased in direct proportion to the increase in the population up to about 1903, but between 1903 and 1917 the increase in consumption was less rapid than the increase in population. In the last half of 1917, flour consumption was sharply reduced under the pressure of war conditions and has since increased only in proportion to the increase in population. The present level of domestic consumption, however, is nearly equal to that which would have resulted if the pre-war trend had continued without interruption. Annual flour production, though following a trend very similar to that of domestic consumption, varies more from year to year, owing to changes in net exports and changes in flour stocks. Fairly large exports and the accumulation of heavy stocks of flour during the year combined to make 1919–20 the record year in American flour production, despite the relatively low domestic consumption.

Thus we have a method for closely approximating the total production in each year.

These differences in total stocks of flour at the beginning and at the end of each period are not always negligible. They constitute the chief obstacle in the way of arriving at accurate estimates of annual flour consumption by the second method and the principal source of the errors in estimates of total production arrived at by that method. It nevertheless appears, as a result of careful study of the various sources of error involved in both methods, that, for the years 1879–80 to 1916–17 and 1921–22 to 1922–23, total flour production can be calculated most accurately by adding together the estimates of domestic consumption and the statistics of net exports and shipments to possessions, with an error probably never over 3 per cent and usually under 1 or 2 per cent. For the years 1917–18 to 1920–21 and 1923–24 to 1926–27, the total flour output may best be arrived at from existing statistics of flour production, the errors in the estimates for these years being probably never in excess of 2 per cent.

The complete series of estimates of production and domestic consumption of flour, by crop years since 1879–80, are given in Appendix Table I and shown graphically in Chart 1.

Estimates of Wheat Ground and Millfeed Produced

The estimates of total wheat ground and millfeed produced each year are obtained by calculation from the estimates of flour production and a new series of estimates of amounts of wheat required per barrel of flour. We find that use of the customary figure of 4.5 bushels of wheat per barrel of flour for this purpose leads to underestimating the quantity of wheat milled annually in recent years by some 20 or 25 million bushels. Furthermore, the wheat required per barrel of flour varies appreciably from year to year, enough in extreme cases to make a difference of over 16 million bushels in the amount of wheat required to produce the same amount of flour in two successive years.

The actual average wheat requirements per barrel of flour for each year can be obtained very accurately for recent years from the monthly milling reports of the Department of Commerce by raising the reported figures 1.5 per cent. The reports represent chiefly the larger mills of the country, which obtain a flour yield slightly above that for the country as a whole. For earlier years, we find that the wheat requirement per barrel of flour can be estimated with only slightly less accuracy from the average test weight of the crops, as estimated by the Department of Agriculture. For the war years, Grain Corporation figures on wheat requirements per barrel of flour are available. The estimates of wheat requirements per barrel of flour for each crop year since 1885–86, based on these data, are given in Appendix Table I and shown graphically in Chart 10 (p. 98).

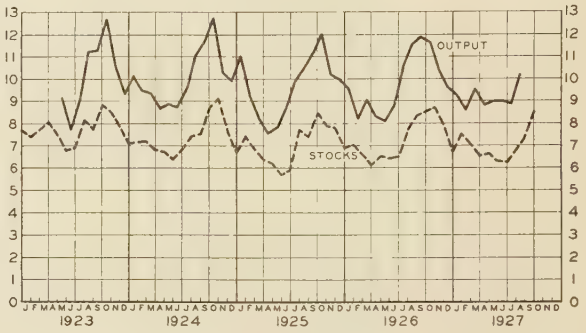
With these figures on wheat milled per barrel of flour and the estimates of total flour produced annually, it is a simple matter to calculate the total quantity of wheat ground and of millfeed produced in each crop year since 1885–86. The resulting estimates are given in Appendix Table I and shown graphically in Chart 11 (p. 99).

Monthly Flour Production since May 1923

The estimates of monthly flour output in the United States since May 1923 are given in Appendix Table II and shown graphically in Chart 2. They are based primarily on the monthly milling reports of the Department of Commerce, but include corrections for errors which result where these figures are raised to "100 per cent" by the usual method. When the reported output shown by the monthly figures of the Department of Commerce is raised to "100 per cent" on the assumption that the production of the reporting concerns represents the same percentage of the total output in the month or year in question as in the previous census years, the resulting figures tend to be always too high.

Chart 2.—Monthly Flour Output and Commercial Stocks, May 1923 to October 1927*

(Million barrels)


OUTPUT
STOCKS
0 1 2 3 4 5 6 7 8 9 10 11 12 13
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1923
1924
1925
1926
1927

* Data in Appendix Table II. Mill output is not only highly seasonal, but there is a wide variation in the output in corresponding months of successive years. The variations in milling activity are found to depend very largely on the disposition of buyers to accumulate stocks of flour. (See pp. 79–81.) Such speculative accumulations do not appear in the primary commercial stocks, as reflected in Russell's series shown here. These are scarcely *stocks* at all, but a *stream* of flour flowing to the consumer at a very uniform rate, though in varying volume depending on the rate of milling.

The assumption that the reporting concerns produced the same percentage of the total output in the month or year in question as in the previous census year implies the assumption that the total output of all other concerns showed the same percentage change between the two periods as the reporting concerns. This is never to be expected, since the list of reporting concerns always includes new establishments which produced nothing during the previous census year, while a list of all the other concerns would show many which went out of business in the interval, their mills being dismantled, taken over by other concerns, or remaining inactive. The tendency toward overestimation involved in the usual method of raising the reported figures to "100 per

cent" increases with the interval between the previous census and the month or year for which the estimate is made, the overstatement amounting to about 1.8 million barrels on a year's production for each twelve months in the interval.

A second correction is required to take account of the output of custom mills. When the output shown by the monthly milling reports is raised to a true 100 per cent, as nearly as that can be approximated, it represents an estimate of 100 per cent of the output of the class of mills covered by the biennial censuses—merchant mills with a value of product amounting to $5,000 or more. The output of the merchant mills omitted may be neglected, but not the output of the custom mills. This is estimated at 1,205,000 barrels, the production shown in the census of 1919.

Changes in Total Flour Stocks

We have found it necessary, as mentioned above, to make a study of changes in flour stocks in the United States in order to determine how closely production in any year corresponds to domestic consumption plus net exports. Our estimates of total flour stocks on the first of each month, in terms of deviations from a 4-year average, are given in Appendix Table II and shown graphically in Chart 5 (p. 78). Several very interesting conclusions have come out of this study.

Total flour stocks in the United States are always several times larger, it appears, than would be indicated by any of the existing statistics. Even more important, it appears that the existing statistics cover classes of flour stocks which are not at all representative of the changes in total flour stocks. The two statistical series available are the monthly figures compiled jointly by the *Daily Trade Bulletin* and the *Daily Market Record* and the series compiled originally by the Grain Corporation and continued by Russell. The *Daily Trade Bulletin* statistics range usually, in recent years, between 1.8 and 2.5 million barrels, while the statistics of Russell and the Grain Corporation range between about 6 and 9 million barrels. The latter series, running about three times as large as the former, shows the same general type of movement, though with numerous differences in detail. The two series are shown graphically in Chart 5 (p. 78) and Chart 6 (p. 79). Both series cover what may be termed *primary commercial stocks,* and the more complete series compiled by Russell and the Grain Corporation probably reflects more accurately the movements of these primary commercial stocks.

Primary commercial stocks of flour, as reflected in the statistical series, clearly represent chiefly flour passing through trade hands to the final user at a very uniform rate. Since the deflation of 1920–21, Russell's stocks figures on the first of each month seem to have equaled almost exactly the total flour production during the previous 20 or 25 days. (See Chart 2.)

Total flour stocks show very different characteristics. Whereas primary commercial stocks represent the volume of a stream of flour flowing at a relatively uniform rate from the mills to the consumer, total flour stocks represent the level of a lake into which the stream flows. The level of the lake is rising most rapidly when the stream is at its highest stage and continues to rise until the flow in the stream has fallen to the point of just equaling the outflow from the lake. Similarly, the level of the lake is falling most rapidly when the stream is at its lowest stage, and does not begin to rise until the flow in the stream has increased to the point of exceeding the outflow from the lake. In consequence of this relationship, the high and low points of total stocks are reached from one to four months after the high and low points, respectively, of commercial stocks. The range of variation is much greater also, total flour stocks having moved through a range of over 7 million barrels during the three years ending with August 1927.

Even more important, it appears that total flour stocks are at times markedly affected by speculative accumulation of flour when prices are expected to rise, and by restriction of buying when prices are expected to fall. Total stocks remained unusually low during the autumn of 1927, for example, under the influence of steadily declining wheat prices, while the sensational rise of prices in 1924–25 led to an accumulation of non-commercial stocks on March 1 nearly 4 million barrels larger than the corresponding figure for the previous

March. Statistics of primary commercial stocks, on the contrary, show no evidence of speculative accumulation in these positions since the deflation of 1920–21.

Order of Detailed Presentation

In the investigation which provided the basis for the estimates here presented, the problem was first visualized much as it has been presented in the foregoing summary. As the study proceeded, it was found that the primary problems under investigation could not be solved satisfactorily until after certain secondary problems had been solved. The trend of flour consumption could not be determined accurately without a basis for estimating changes in total flour stocks between the beginning and the end of census years. This required a knowledge of the characteristics of total flour stocks which was not in existence. To obtain information on the characteristics of total flour stocks, it was necessary first to derive more accurate estimates of monthly flour output over a period of years than have been available hitherto, and from these to obtain a series reflecting fairly well the changes in total flour stocks over several years.

In the detailed presentation of the study, to which we now proceed, it is necessary to follow the order employed in the investigation rather than the superficially more logical order of presentation used in the foregoing summary. We start by developing a method of deriving more accurate estimates of monthly flour output from the incomplete figures reported by the Department of Commerce since May 1923. We next investigate the characteristics of total flour stocks, making use of data which may be derived from the Grain Corporation statistics and Russell's estimates of monthly flour output, and especially of a new series which we derive, showing the monthly movement of total flour stocks since May 1923. With this information in hand, we are able to develop improved estimates of annual flour consumption for the crop years 1879–80 to 1916–17. Estimation of annual flour consumption since July 1917, requiring the assembling of much additional information, is next undertaken. On the basis of the estimates of annual consumption and other statistics of disposition, we are then able to prepare annual estimates of total flour production which, with direct estimates of production for certain years, provide a trustworthy continuous series of production estimates by crop years from 1879–80 to 1926–27.

To obtain estimates of quantities of wheat ground and of millfeed produced annually, it is necessary first to make a study of variations in the quantity of wheat ground per barrel of flour, as reflected in the census statistics, the Grain Corporation statistics, and the milling reports of the Department of Commerce. This study provides a basis, with other data, for annual estimates of wheat ground per barrel of flour by crop years from 1885–86. These estimates and the estimates of total flour output by crop years permit calculation of the approximate quantities of wheat ground and of millfeed produced annually from 1885–86.

II. MONTHLY FLOUR PRODUCTION SINCE MAY 1923

Available Data and Their Shortcomings

In connection with each of its monthly milling reports, instituted in May 1923, the Department of Commerce publishes a statement of the percentage of the total output reported at the previous census, which was produced in that census year by the mills (or concerns)[1] currently reporting. It publishes also a statement of the production over several months of a group of identical concerns, all of which reported each month,[2] together with their percentage of the total output reported at the previous census. Making use of these published percentages, the reported production for any month or year is commonly raised to 100 per cent by

[1] Prior to March 1927, the statement was worded, in general, as follows: "These mills produced approximately ___ per cent of the total wheat flour reported at the biennial census of manufactures in 19__."

In the report for March 1927 and in subsequent reports the statement runs, in general, as follows: "Of these _____ concerns, _____ which were in operation in 1925 produced approximately _____ per cent of the total wheat flour reported at the biennial census of manufactures for that year."

The statement now used is the more precise description of the practice which has been followed from the beginning in the computation of these percentages.

[2] The concern is treated by the Department of Commerce as the real unit in these tabulations and the

dividing by the corresponding percentage, it being assumed that if a given group of mills produced, for example, 85 per cent of the total output in the previous census year, it likewise produced 85 per cent of the total in the latest month or year. This method of calculation may be applied either to the reports for the groups of identical concerns or to the total for all the mills reporting.

This customary method of estimating the total flour output from the Department of Commerce reports yields results which appear to be invariably somewhat too high. The amount of the excess is not uniform from year to year, having varied apparently from about 2 per cent to 6 or 7 per cent since 1923. It nevertheless exhibits characteristics over a period of time such that a correction can be applied which removes the larger part of the error.

Prior to January 1925 the current milling reports had to be raised to 100 per cent on the basis of percentages derived from the census of 1921. In the milling report for January 1925, the results of the 1923 census having become available, the necessary data were given for raising the 1924 reports on the basis of a percentage derived from the census of 1923. Employing the new basis for the calculation, the total production during 1924 appeared to be 5,100,000 barrels less than it had appeared when calculated with the percentage derived from the census of 1921. Similarly, when the results of the 1925 census became available, the new basis of calculation yielded an estimated total production for 1926, 3,500,000 barrels less than had been indicated by the calculations using the percentage derived from the census of 1923. With publication of the results of the 1925 census it became apparent also that the 1925 total as previously estimated by the customary method was about 2,600,000 barrels too high.

These facts may be summarized conveniently in the following tabulation, in million barrels, covering the three calendar years for which the data are available.[1]

	1924	1925	1926
Reports raised on basis of percentage for previous census year	120.8	117.3	117.7
Reports raised on basis of percentage for next earlier census year	125.9	....	121.1
Census enumeration	....	114.7	....
Difference	5.1	2.6	3.5

An explanation of the tendency for the estimated totals to run too high is found in a combination of several facts. Probably most important is the fact that, with new concerns being established each year and old concerns going out of business, any large and representative group of concerns in operation during a given year tends to produce a larger percentage of the total output in that year than in a previous year; such a group naturally includes some concerns that were not in existence in the previous year and of course includes none of the concerns which have gone out of business in the interval. Of the 866 concerns which reported in time for the monthly milling report of August 1927, 22 were not in operation in 1925. There is no record of the change in number of mills operated by the 844 concerns which were in operation in 1925 as well as in 1927, or of the number of concerns which were in operation in 1925 but not in August 1927, but the changes in both respects must have contributed toward the production by the reporting concerns of a larger percentage of the total output in 1927 than in 1925.[2]

A further cause of the tendency for the estimated totals to run too high is to be found in the fact that the larger mills are much more completely represented in the monthly reports than the smaller mills and that there has been under way in the milling industry for many years a tendency for the larger mills to turn out, year by year, a larger percentage of the total output of the country. In the monthly milling reports the trend toward increased production by the larger mills is reflected quite completely, while the offsetting trend toward decreased production by the smaller mills has little effect on the reported totals.

term "identical mills" formerly used has recently been replaced by the more accurate term. It should be noted that concerns are included in these groups which were not in operation during the previous census year.

[1] For the calculations based on the monthly milling reports the figures for "identical concerns" have been used in each case.

[2] An interesting summary of recent changes in the Northwest is given by Robert T. Beatty in the *Northwestern Miller*, November 16, 1927, p. 625. He states, for example, that "the outstanding feature of these annual figures is the apparent steady increase in production of the larger interior mills and the gradual elimination of the small grist mills."

These conditions leading to overstatement of the total production when estimated from the monthly milling reports by the usual method may be supposed to be operating fairly uniformly, so that the overstatement from these causes in any year should be approximately the same as in any other year, given equal intervals between the year for which the percentage was calculated and the year to which the calculation applies.

There are other conditions leading to errors in the estimated totals, however, which do not operate systematically. Among these are the variations in percentage of the total output produced by the classes of mills most completely represented in the reports, arising from variations in the size and quality of the wheat crop in different areas, variations in export demand, and other causes. The combined result of these two sets of conditions is that the estimated totals as usually obtained are probably always above the actual output, but by varying amounts, hence the variation in the differences shown in the tabulation above.

Method of Deriving Estimates of Total Production

It is impossible to make correction, on the basis of the published data, for the effects of conditions which operate irregularly from year to year; but the general tendency for the estimated totals to run too high, as a result of the conditions (discussed above) which probably operate quite uniformly from year to year, may be readily corrected. Such conditions naturally lead to an overestimate roughly proportional to the length of the interval between the year for which the percentage is calculated and the month or year for which the estimate is made. The amount of the overestimate which results when the interval is two years may be judged either by comparison of a census figure with an estimate for the same year, based on a percentage derived from data for the previous biennial census year, or by comparison of two estimates for the same year, based on percentages derived from data for two successive biennial census years. The first of these comparisons is possible for the calendar year 1925 only, the second only for the calendar years 1924 and 1926. The three possible comparisons, shown in the tabulation on page 69, above, show discrepancies, in chronological order, of 5.1, 2.6, and 3.5 million barrels or an average discrepancy of 3.7 million barrels.

It appears, therefore, that the conditions which tend uniformly to produce an overestimate of total flour output, as calculated from the monthly milling reports, result in an overestimate of about 3.7 million barrels whenever the percentage employed in the calculation is derived from data of a period two years earlier. It appears, further, that the influence of other conditions may modify this error, in either direction, by something like 1 or 1.5 million barrels.

On the basis of this information, we have adopted the following method for calculating the revised series of estimates of monthly flour production in the United States since May 1923. We first raise the reported figures to 100 per cent by the usual method, using by preference the totals for all mills reporting as revised in the statement following that in which they are first given. These totals are presumably somewhat more representative than the totals for the identical concerns, and their use yields a further advantage from the fact that since all the percentages, over most of the period, are published only to two digits, the resulting inaccuracies in the estimated totals for any year will probably be smaller when the varying percentages for all reporting concerns are used rather than the constant percentage for a group of identical concerns. It is desirable, however, to raise the reported figures on the basis of the most recent percentage figure available. Throughout 1924 and 1926 a more recent percentage figure may be used by employing the reports for identical concerns.

Having raised the reported output, monthly, by the usual method, we apply a correction for the uniform tendency to overestimation. This tendency may be regarded as a bias, the effect of which accumulates uniformly with the increase in the interval between the period from which the percentage is derived and the period for which the estimate is made. Since the effect of the bias amounts to about 3.7 million barrels on the total annual production at the end of a 2-year interval, the monthly accumulation of error may be taken in

round figures at 150,000 barrels, on the total annual production, or on the monthly production, one-twelfth of this amount, or 12,500 barrels.[1] To apply this correction, the reported output for each month raised to "100 per cent" is reduced by 12,500 barrels, times the number of months intervening between July of the census year for which the percentage was calculated and the month for which the estimate is made.

For the calendar year 1925 the monthly figures thus obtained are further adjusted by addition of 184,000 barrels each month to make the total for the twelve months equal the census figure for that year.

Account must also be taken of the fact that the biennial censuses of manufactures omit the production of custom mills and of merchant mills with a value of product under $5,000. The steps described above result in estimates of flour output comparable in their inclusiveness with the enumeration of the biennial censuses and therefore taking no account of the flour output omitted in those censuses. The output of the merchant mills omitted in the biennial censuses is apparently under 0.3 per cent of the total output,[2] and may be neglected. Adopting the method employed by the Department of Agriculture,[3] the annual output of custom mills may be estimated, in the absence of better information, at the figure shown by the last decennial census, 1,205,000 barrels, or with sufficient accuracy, 100,000 barrels per month. Adding this amount monthly to the figures previously derived brings the figures to their final form as given in Appendix Table II and shown graphically in Chart 2 (p. 66).

Possible Error in These Estimates

It is desirable to form some idea of the degree of error to be expected in these estimates of monthly and yearly flour production.[4] Though they constitute a material improvement on previous estimates, they necessarily fail of perfection, and in the uses subsequently to be made of the estimates it is important to know the approximate magnitude of the errors to which they are subject.

Reviewing the possible sources of error, it must be recognized that since the base points for the entire calculation are obtained from the census data, any deficiencies in the census figures must affect the estimates by a like amount. We know of no evidence that the census figures are not substantially accurate,[5] and accordingly we regard this possible source of error as probably negligible. The rough character of the estimate for production of custom mills cannot introduce appreciable error, since the amounts involved are so small relative to the total; complete omission of the figures would introduce an error of only 1 per cent in the total. The only important possibility of error seems to lie in the fact that the mills included in the monthly milling reports are not entirely representative of all the merchant mills of the country.

[1] The nature of the error for which this correction is made suggests the subtraction of a steadily increasing *percentage* of each month's production as probably more appropriate than the subtraction of a steadily increasing number of barrels. In view of the very slight difference in the figures that would be obtained by the two methods and some uncertainty as to which is really the more accurate procedure, the simpler method has been adopted.

[2] In 1921 the value of products of merchant mills in the "less than $5,000" class was 0.3 per cent of the total value of the products of all merchant mills; in 1919, 0.2 per cent. (Cf. *Census of Manufactures, 1921*, Table 60, p. 96.)

[3] For example, in *Wheat and Rye Statistics* (U.S. Department of Agriculture, Statistical Bulletin 12, January 1926), Table 85, note 2.

[4] Throughout this study we have undertaken, wherever possible, to indicate approximately the degree of error to which the estimates seem to be subject. In preparing all the principal estimates we have carried our investigations far enough to know fairly well the importance of factors the influence of which could not be given consideration in the estimates, and this knowledge may be summed up most effectively in the form of estimates of the errors which may have resulted in consequence of such omissions. It is quite possible that some sources of error may have escaped our attention, but we believe the estimates of possible error, as given, provide a trustworthy basis for judging the degree of confidence to be placed in the figures and for warning against drawing conclusions not justified by the limited accuracy of the figures.

[5] It is clear, however, that there is a small volume of flour production not included in any of the census figures even as supplemented, where necessary, by estimates of output of custom mills. The *Census of Manufactures, 1923*, states (p. 103, note 1) that "In addition, flour, meal, and other products normally belonging to the flour-mill and grain-mill industry were reported as subsidiary products by establishments classified in other industries (principally the manufacture of breakfast foods) to the following values: For 1923, $5,997,789; for 1921, $5,596,421; for 1919, $17,431,368; for 1914, $9,046,449." The value of these products, only a portion of which is wheat flour, represented in 1923 less than 0.6 per cent of the value of products reported for the industry.

The only available indications of the possible error from this source must be obtained from data such as that shown in the tabulation on page 69 above, with allowance for the greater accuracy resulting from our correction for a uniform bias as revealed in those figures. On this somewhat narrow basis it appears that our estimates of annual production for other than census years are probably always within 1.5 million barrels, or say 1 to 1.5 per cent of the figures that would be shown by a census covering the same years. The percentage error in the estimates for individual months may be expected to run slightly larger, with 2 per cent as the probable maximum error.

III. CHANGES IN TOTAL FLOUR STOCKS

Evidence of Large Changes

If any of the available series of monthly statistics or estimates of flour production in the United States[1] be taken as the basis for a calculation of monthly domestic disappearance, the resulting figures show a degree of variation which cannot possibly be considered to represent variations in actual consumption of flour. In almost any year, two or more successive months will be found in which the domestic disappearance is more than 50 per cent above that in other series of months. The conclusion is unavoidable that the periods of rapid disappearance (usually from September to November) represent periods in which substantial flour stocks are being accumulated, and that the periods of low disappearance represent periods in which these stocks are being reduced. Moreover, the disappearance figures show practically the same characteristics when adjustment is made for the changes in stocks covered by the existing statistics as when no such adjustment is made. Apparently the available statistics of stocks are very incomplete, perhaps not at all representative of the changes in total stocks.

For illustration, we may take the monthly flour disappearance figures calculated by the United States Grain Corporation for the two crop years 1918–19 and 1919–20. The monthly flour production statistics for this period are probably more accurate than the monthly figures for any other period, being comparable with census enumerations. The total of the production figures shown for the twelve months of 1919 is 132,334,000 barrels, almost exactly equal to the figure of 132,465,000 barrels for merchant mills subsequently obtained by the decennial census. Calculation of the domestic disappearance for each month on the basis of these production statistics, the Department of Commerce statistics of exports, the records of shipments for the American Expeditionary Forces, the American Red Cross, the Belgian Relief, and the Northern and Southern Relief (none of which is included in the Department of Commerce export statistics), and the stocks at the beginning and at the end of each month, as compiled by the Grain Corporation, yields the figures shown in Table 1 and graphically in Chart 3.

Table 1.—"Apparent Consumption" of Flour, Monthly, 1918–19 and 1919–20*

(Thousand barrels)

Month	1918–19	1919–20
July	4,562	5,215
August	6,445	8,376
September	10,660	9,917
October	8,825	11,902
November	8,526	10,833
December	11,281	10,871
January	4,797	13,416
February	5,437	7,844
March	8,800	7,462
April	8,498	5,164
May	7,829	7,207
June	5,401	7,592

* Data from United States Grain Corporation, *Supplement to Grain and Flour Statistics during the War* (1920), p. 22.

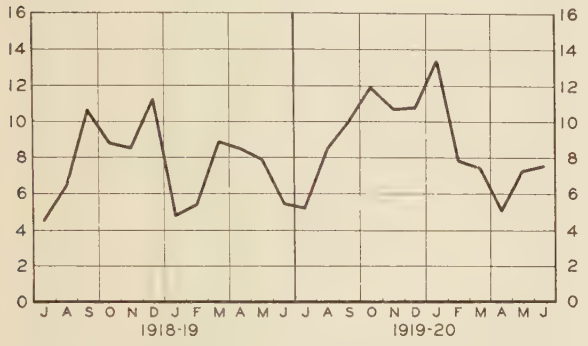
If the disappearance statistics be totaled separately for the two halves of each crop year, July–December and January–June, it develops that the disappearance during the first half of the 1918–19 crop year was 9.5 million barrels more than during the second half of the crop year. In 1919–20 the difference between the disappearance in the first half of the crop year and that in the second half was 8.5 million barrels.

[1] Including Russell's estimates, the Grain Corporation statistics, the estimated monthly totals as usually calculated from the monthly milling reports, or our revised estimates of monthly production.

These differences in disappearance cannot be accounted for, even in small part, on the ground of differences in actual consumption of flour between the two halves of each crop year. Indeed, such difference as exists between the actual consumption in the two halves of each crop year must be in the direction of larger consumption in the second half. Bread consumption, and therefore flour consumption, is supposed, probably rightly, to be somewhat heavier in cold

CHART 3.—"APPARENT CONSUMPTION" OF FLOUR, MONTHLY, 1918–19 AND 1919–20*

(Million barrels)



* The data on which this chart is based (Table 1) were compiled by the Grain Corporation and represent the most trustworthy monthly statistics of this sort obtainable for any period. The production statistics used in the computation represent actual reports comparable with the censuses in completeness. From the output for each month are subtracted the net exports and other shipments and changes in flour stocks, as reported to the Grain Corporation. It is quite inconceivable, however, that actual consumption varied in anything like this degree. There must have been heavy accumulations of unreported flour stocks between September and December of 1918, and still heavier accumulations between September 1919 and January 1920.

weather than in warm weather, and there is slightly more cold weather in the six months following January 1 than in the six months preceding that date. The steady growth of the population of the United States, amounting to some 750,000 every six months, tends to increase consumption in the second half of each crop year about a third of a million barrels over that in the first half. In 1918–19 there was the added fact that nearly three-fourths of the first six months of the crop year fell in the period before the armistice, when the rate of flour consumption may have been lower than in subsequent months. The only significant factor we think of that tends toward smaller consumption during the last six months of a crop year lies in the fact that those months include three less days (in a leap year, two less days) than the six months from July to December inclusive. Altogether, it appears that differences in disappearance of flour between the first six months and the second six months of a crop year must be accounted for largely on the ground of changes in flour stocks.

Given these facts regarding flour consumption, it is still not possible to determine from the differences in disappearance of flour between two halves of a crop year precisely what changes have taken place in flour stocks between July 1 and December 31 and between January 1 and June 30, but one can state with certainty that between the beginning and the end of one of these periods the change in stocks must have been at least as great as half the difference between the two disappearance figures. It is also clear that half of this difference gives the excess of flour stocks on January 1 over the mean of the totals at the beginning and at the end of the crop year.[1] Accordingly, it appears that since the flour disappearance during the six months July–December 1918 was 9.5 million barrels greater than during the six months January–June 1919, after allowing for the change in statistics of flour stocks, stocks not covered in the statistics must have been some 4.7 million barrels larger on January 1, 1919 than the mean of the corresponding figures for July 1, 1918 and July 1, 1919.

[1] Taking c_1 = flour consumption in the six months, July–December,
c_2 = flour consumption in the six months, January–June,
d_1 = flour distribution in the six months, July–December,
d_2 = flour distribution in the six months, January–June, and
s_1, s_2, s_3 = total stocks of flour in all positions on July 1, January 1, and June 30, respectively; then

$$c_1 = s_1 + d_1 - s_2,$$

and

$$c_2 = s_2 + d_2 - s_3$$

And if $c_1 = c_2$, as has been shown above to be substantially the case,

$$s_1 + d_1 - s_2 = s_2 + d_2 - s_3,$$
$$d_1 - d_2 = (s_2 - s_1) + (s_2 - s_3),$$

and

$$\frac{d_1 - d_2}{2} = s_2 - \frac{s_1 + s_3}{2}$$

Furthermore, if $s_1 = s_3$,

$$s_2 - s_1 = s_2 - s_3 = \frac{d_1 - d_2}{2}$$

Otherwise, either $s_2 - s_1$ or $s_2 - s_3$ must be greater than $\frac{d_1 - d_2}{2}$.

A calculation of disappearance for the same months, neglecting the statistics of stocks, shows a difference of 15.2 million barrels, from which it appears that total flour stocks in the United States on January 1, 1919 were some 7.6 million barrels larger than the mean of the totals for July 1, 1918 and July 1, 1919. The same calculation for 1919–20 reveals a difference in disappearance between the two 6-month periods amounting to 22.6 million barrels, indicating that total flour stocks on January 1, 1920 were 11.3 million barrels larger than the mean of the totals for July 1, 1919 and July 1, 1920.

These figures are large enough to suggest the desirability of making similar calculations for all the years for which monthly data are available. Using the Grain Corporation figures discussed above for the crop years 1918–19 and 1919–20, Russell's estimates of monthly output for the crop years 1914–15 to 1917–18 and 1920–21 to 1922–23, and our revised estimates of monthly output for the crop years 1923–24 to 1926–27, we obtain the following figures for the excess of total flour stocks on January 1 of each year over the means of the totals on July 1 preceding and July 1 following, in millions of barrels:

1915.... 8.5	1919.... 7.6	1923.... 7.9
1916.... 6.3	1920....11.3	1924.... 3.7
1917.... 6.8	1921.... 2.2	1925.... 5.2
1918....12.7	1922.... 8.0	1926.... 5.2
		1927.... 4.6

The conclusion is inevitable from these data that the quantity of flour on hand in the United States on the first of January varies from year to year through a range of several million barrels. The data forming the basis for these calculations are not perfect—Russell's estimates of flour output over the period from July 1920 to May 1923, in particular, are based on a decidedly incomplete record of milling output—but such errors as may exist can account for only a small portion of the variation shown by the figures in the table above. Indeed, the figures for years for which the data are most reliable show some of the most extreme values: the next to the highest figure in the table, indicating flour stocks on January 1, 1920, 11,330,000 barrels above the mean of the stocks figures of the preceding and of the following July 1, is derived from the very accurate data of the Grain Corporation, and the next to the lowest figure, indicating stocks on January 1, 1924, only 3,700,000 barrels above the mean of stocks on the preceding and on the following July 1, is derived from our revised estimates of monthly flour production.

Interpreting these figures in terms of variation in total stocks of flour in the United States on January 1, it appears that a change of 2 million barrels between successive January's is not uncommon and that under extreme conditions the change may be several times as large. This being the case, the domestic disappearance of flour during a calendar year, when calculated without allowance for changes in stocks, may not infrequently exceed the actual consumption (or fall short of it) by as much as 2 million barrels; under extreme conditions the disappearance may differ from the actual consumption by several times this amount.

This question of the changes in total flour stocks under varying conditions is worth pursuing farther, since it is now apparent that figures on flour disappearance for calendar years, such as those obtainable for census years, may safely be interpreted in terms of actual consumption only after giving due consideration to the change in total flour stocks between the beginning and the end of the year.

Monthly Changes in Total Stocks

Our revised estimates of monthly flour output since May 1923 provide a basis for a calculation which will throw much additional light on the subject. The change in total flour stocks in any month is obviously the difference between the production and the combined total of net exports and consumption in that month. We have the estimates of production, with sufficient accuracy, and excellent statistics of imports and exports. The monthly consumption since May 1923 may readily be estimated, probably with at least the accuracy obtaining in the production estimates.

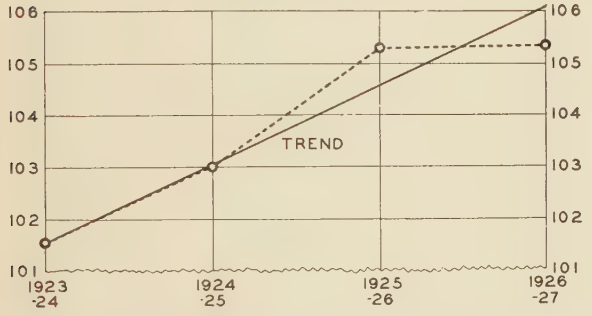
To estimate the monthly consumption of flour, we start with the assumption that since May 1923 the average daily consumption of flour each month has exceeded that of the month before by a uniform, readily

determinable amount. This assumption is probably in error in neglecting a small seasonal variation in the rate of flour consumption, perhaps also in neglecting other slight irregularities in the rate of flour consumption. After making the calculations on this basis, we shall consider the degree to which errors in this assumption may have affected the results.

As a basis for estimating the average daily rate of flour consumption each month we need to calculate the average daily rate for any one month and the average change in this rate from month to month. For this purpose, the statistics of apparent annual consumption by crop years, 1923–24 to 1926–27, may be used. The data are shown graphically in Chart 4. The statistics are

CHART 4.—DOMESTIC DISAPPEARANCE OF FLOUR BY CROP YEARS, 1923–24 TO 1926–27*

(Million barrels)



* Domestic disappearance of flour, when calculated by crop years, seldom differs much from the actual domestic consumption. The figures for domestic disappearance, derived from our revised estimates of flour production, provide a reliable basis for calculating the trend of flour consumption, represented by the light solid line. A steady increase in consumption is indicated, at practically the same rate as the increase in population of the United States, the trend line reflecting a consumption of slightly over nine-tenths of a barrel per capita in each year.

taken by crop years rather than by calendar years, partly because there are four complete crop years in the period covered by the statistics and only three complete calendar years, chiefly because changes in stocks appear to be usually much smaller between corresponding dates in midsummer than between corresponding dates in midwinter, making the apparent consumption by crop years the more reliable index of actual consumption.

The trend of the annual consumption statistics shown in Chart 4, indicated by the light solid line, shows the apparent trend of actual consumption during this period, in terms of the totals for 12-month periods. It appears that the actual consumption in 1924 was 102,296,000 barrels, and that it has been increasing at the rate of 1,508,000 barrels a year.[1] Converting these figures to the basis of average daily consumption and rate of change per month in the daily consumption gives an indicated average daily consumption of 275,450 barrels for May 1923, with an increase in each succeeding month of 344 barrels in the average daily consumption.

Taking from Appendix Table II the monthly figures for domestic disappearance and domestic consumption, the apparent change in total stocks between the beginning and the end of each month is readily calculated (Table 2, column 3, p. 76), as also the total apparent change from the first of May 1923 to the end of each succeeding month (column 4). The figures may be placed in still more significant form by expressing them in terms of deviations from the average first-of-the-month total stocks for the four crop years, July 1923 to June 1927 inclusive.[2] This is done in column 5 of Table 2.

These estimates of total flour stocks in the United States on the first of each month, expressed in terms of deviations from the average total stocks for the four complete crop years covered, are shown graphically in Chart 5 (p. 78), and reveal several very interesting facts, to be discussed shortly. In connection with the estimates of total

[1] It is interesting to note that this reflects a practically constant per capita consumption at a rate of .902 barrels per year.

[2] We have no statistical basis for calculating this average, but such a calculation is unnecessary. Let X represent this average; S_0 represent total stocks on the first of May 1923, and S_i total stocks on the first of any other month we may choose to take; C_i represent the change in total stocks between the first of May 1923 and the first of any other designated month (or the end of the previous month), and x represent the mean of these values, as tabulated, for the 48 months from July 1923 to June 1927.

Since X is the mean of the values of S_i over a 48-month period and x is the mean of the values of C_i, therefore of $S_i - S_0$, over the same period, we may write:

$$x = X - S_0 \quad \ldots\ldots\ldots\ldots\ldots \quad (1)$$

By definition,

$$C_i = S_i - S_0 \quad \ldots\ldots\ldots\ldots\ldots \quad (2)$$

Subtracting equation (1) from equation (2),

$$C_i - x = S_i - X$$

Since we have in column 4 of Table 2 estimates of C_i for each month, the values of $C_i - x$ may readily be calculated and treated as values of $S_i - X$, subject only to such errors as may exist in the estimates of C_i.

flour stocks, monthly, it is useful to have also the data for flour stocks outside the primary commercial stocks covered by Russell's figures. These are readily derived in terms of deviations from the 4-year average, and are given in Appendix Table II. the trend of the curve. The method of calculation made it inevitable that total stocks on July 1, 1927 should appear the same as total stocks on July 1, 1923;[1] in other words, a substantially horizontal trend was assumed, by implication, at the outset. As a

TABLE 2.—CALCULATION OF CHANGES IN TOTAL FLOUR STOCKS, MONTHLY FROM MAY 1, 1923

(Thousand barrels)

Year and month	Domestic disappearance[a]	Consumption[a]	Change in total stocks		Total stocks first of month[d]	Year and month	Domestic disappearance[a]	Consumption[a]	Change in total stocks		Total stocks first of month[d]
			During month[b]	Since May 1, 1923[c]					During month[b]	Since May 1, 1923[c]	
1923	(1)	(2)	(3)	(4)	(5)	1925	(1)	(2)	(3)	(4)	(5)
May....	8,127	8,539	— 412	— 412	—1,097	Sept....	10,272	8,552	+1,720	+ 659	—2,158
June...	6,928	8,274	—1,346	—1,758	—1,509	Oct.....	10,938	8,848	+2,090	+2,749	— 438
July....	8,130	8,560	— 430	—2,188	—2,855	Nov.....	9,255	8,573	+ 682	+3,431	+1,652
Aug.....	9,950	8,571	+1,379	— 809	—3,285	Dec.....	8,928	8,870	+ 58	+3,489	+2,334
Sept....	9,692	8,305	+1,387	+ 578	—1,906	1926					
Oct.....	10,549	8,592	+1,957	+2,535	— 519	Jan.....	8,794	8,880	— 86	+3,403	+2,392
Nov.....	8,741	8,326	+ 415	+2,950	+1,438	Feb.....	7,484	8,030	— 546	+2,857	+2,306
Dec.....	7,458	8,614	—1,156	+1,794	+1,853	Mar.....	8,335	8,902	— 567	+2,290	+1,760
1924						Apr.....	7,417	8,625	—1,208	+1,082	+1,193
Jan.....	8,298	8,624	— 326	+1,468	+ 697	May....	7,362	8,923	—1,561	— 479	— 15
Feb.....	7,882	8,078	— 196	+1,272	+ 371	June...	8,010	8,645	— 635	—1,114	—1,576
Mar.....	7,937	8,646	— 709	+ 563	+ 175	July....	9,637	8,944	+ 693	— 421	—2,211
Apr.....	7,538	8,377	— 839	— 276	— 534	Aug.....	10,027	8,955	+1,072	+ 651	—1,518
May....	7,860	8,667	— 807	—1,083	—1,373	Sept....	10,218	8,676	+1,542	+2,193	— 446
June...	7,522	8,398	— 876	—1,959	—2,180	Oct.....	10,181	8,976	+1,205	+3,398	+1,096
July....	8,712	8,688	+ 24	—1,935	—3,056	Nov.....	8,968	8,697	+ 271	+3,669	+2,301
Aug.....	10,021	8,699	+1,322	— 613	—3,032	Dec.....	8,317	8,997	— 680	+2,989	+2,572
Sept....	10,188	8,429	+1,759	+1,146	—1,710	1927					
Oct.....	10,782	8,720	+2,062	+3,208	+ 49	Jan.....	8,179	9,008	— 829	+2,160	+1,892
Nov.....	8,646	8,449	+ 197	+3,405	+2,111	Feb.....	7,654	8,146	— 492	+1,668	+1,063
Dec.....	8,387	8,742	— 355	+3,050	+2,308	Mar.....	8,598	9,030	— 432	+1,236	+ 571
1925						Apr.....	7,733	8,749	—1,016	+ 220	+ 139
Jan.....	9,946	8,752	+1,194	+4,244	+1,953	May....	7,825	9,051	—1,226	—1,006	— 877
Feb.....	8,235	7,915	+ 320	+4,564	+3,147	June...	8,075	8,769	— 694	—1,700	—2,103
Mar.....	6,772	8,774	—2,002	+2,562	+3,467	July....	8,013	9,072	—1,059	—2,759	—2,797
Apr.....	6,544	8,501	—1,957	+ 605	+1,465	Aug.....	9,082	9,083	— 1	—2,760	—3,856
May....	7,063	8,795	—1,732	—1,127	— 492	Sept....	9,716	8,800	+ 916	—1,844	—3,857
June...	7,742	8,522	— 780	—1,907	—2,224	Oct.....	10,023[e]	9,104	+ 919[e]	— 925[e]	—2,941
July....	8,986	8,816	+ 170	—1,737	—3,004	Nov.....	.....	.....	.....	.....	—2,022[e]
Aug.....	9.503	8.827	+ 676	—1.061	—2.834						

[a] Cf. text and Appendix Table II. [b] Domestic disappearance minus consumption. [c] Values in column 3 cumulated.
[d] Deviations from 4-year average, July 1, 1923, to June 1, 1927. Obtained from column 4 by subtracting 1,097 from the calculated change, May 1, 1923, to the end of the previous month. Cf. p. 75.
[e] Preliminary.

For brevity they may be called "total noncommercial flour stocks."

LIMITATIONS OF THESE ESTIMATES

In examining the figures on changes in total flour stocks, it is well to bear in mind certain limitations of the estimates, arising from the method of derivation and from the possibility of errors in the data employed. The most significant limitation relates to matter of fact, there has probably been a slight upward trend in total flour stocks over this period, with the growth in population and total flour consumption in the United States.

If the trend of daily flour consumption in the United States has differed slightly from that employed in the calculations, the form

[1] The total consumption over this period was assumed equal to the total distribution.

of the trend of flour stocks is slightly in error. If consumption increased more rapidly than indicated by our calculations, the flour stocks curve should have been bowed upward in the middle, following a parabolic trend. If consumption increased less rapidly than indicated by our calculation, the flour stocks curve should be bowed correspondingly downward. It seems quite unreasonable, however, to assume any error of significant magnitude in either direction. The changes required in the flour stocks curve on either of these assumptions would make it conform much less closely with other evidence as to its probable course. Even more weighty evidence of the substantial accuracy of the slope of the calculated trend of flour consumption is revealed subsequently (pp. 89–91) when it is found that this consumption trend, extended back four and a half years, agrees very well with the statistics of flour production and distribution for the entire period since January 1919, or, with an adjustment for the absence from the United States of the men in the American Expeditionary Forces, with the statistics of flour production and distribution since January 1918.[1]

The assumption of a steady upward trend in daily flour consumption throughout the year ignores a seasonal variation which probably exists. Even though daily flour consumption is considerably higher in cold weather than in warm, however, the average daily consumption between July 1 and January 1 and between January 1 and the next July 1 cannot differ materially from the average of the figures given by the trend used, for each half year includes nearly the same amount of hot and of cold weather. In consequence, the calculated stocks on January 1 and July 1 cannot be materially affected by neglect of the seasonal variation. The chief effect of this neglect must appear in the form of the curves between January 1 and July 1. Stocks during the late summer and the fall must be slightly understated, stocks during the late winter and the spring slightly overstated, the amount of the under- and overstatement in these periods depending on the amplitude of the seasonal variation in daily flour consumption. One may doubt whether the discrepancies from this source are sufficient to be perceptible on a chart without close comparison of the correct and the erroneous curves. In any case, they have no bearing on the features of the stocks curve which we shall shortly point out as most significant.

Possible errors in the flour production estimates may be of greater consequence. If the production estimate over a 12-month period is a million barrels above or below the facts,[2] it will result in a spurious increase or decrease of a million barrels in the stocks figures over the same period. Some such errors must be expected, and it is quite possible that they may be as great as 1 or even 1.5 million barrels over a 12-month period.[3]

Relation of Total Stocks to Primary Commercial Stocks of Flour

The most significant fact to be derived from a study of the series reflecting changes in total flour stocks comes to light when this series is compared with previous compilations of flour stocks statistics. In Chart 5 (p. 78) are shown, in addition to the estimates of total stocks, expressed as deviations from their 4-year average, the statistics of flour stocks compiled jointly by the *Daily Trade Bulletin* and the *Daily Market Record* and those compiled by Russell for the same period. There is no similarity whatever between the movements of the two series representing a small portion of the total stocks and the series representing the changes in the whole. Not only do they regularly reach their high and low points

[1] To obtain the best agreement, the slope of the trend must be slightly altered to show total consumption increasing 1⅔ per cent a year instead of 1½ per cent. This difference of ⅙ of one per cent in the rate of increase shown by the two methods of calculation is negligible. Existing statistics are not accurate enough to show which of two figures, differing by such a small amount, is nearer the facts. Both may be regarded as indicating a substantially constant per capita consumption of flour since the war.

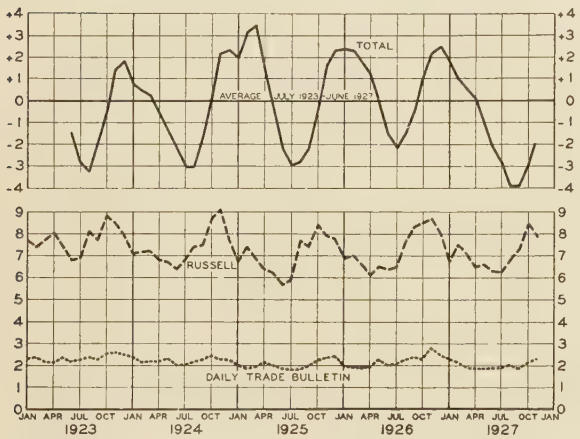
[2] We assume that the estimates are as likely to be over the facts as under. If, owing to defects in the census data or some other unrecognized circumstances, the estimates all tend to be too high or too low, error will be introduced in the stocks figures only to the degree that the error in the production estimates is variable. The consumption estimates being derived from the production estimates, a constant error in the one must be present to the same degree in the other, leaving the estimates of changes in flour stocks unaffected.

[3] The possible errors in the production estimates are discussed above, pp. 71–72.

at different times, but even the direction of the changes in the two partial series between corresponding dates a year apart shows no regular correspondence with the direction of the changes in total stocks over the same intervals.

CHART 5.—MONTHLY MOVEMENT OF TOTAL FLOUR STOCKS AND TWO STATISTICAL SERIES FOR COMMERCIAL FLOUR STOCKS*

(Million barrels)



* Data as of the first of each month, from Appendix Table II and from the Chicago *Daily Trade Bulletin*. The statistical series for commercial flour stocks are in no sense representative of total flour stocks, and are of no value in estimating the changes in total stocks of flour. Total flour stocks are usually built up rapidly in the fall to a high point on the first of December. Thereafter, stocks are normally allowed to decline fairly steadily until July or August, but, when higher prices are feared, stocks may be maintained at high levels for several months. The large changes in the level of stocks which may occur between successive January's sometimes result in material differences between domestic disappearance, as calculated for calendar years, and actual domestic consumption of flour.

The reason for the lack of similarity between the two partial series and the series representing changes in total flour stocks appears clearly from a little study of the two partial series. As plotted in Chart 5, Russell's series and the *Daily Trade Bulletin* series (which runs about one-third as large) show little resemblance between themselves. When plotted with a logarithmic vertical scale, however, so that the chart reflects truly the relative size of the changes, the two curves show a very fair degree of correspondence. In Chart 6, the two series are so shown over the entire period for which the more inclusive series is available. Comparing Russell's statistics of flour stocks with the monthly flour output (Chart 2, p. 66), a striking resemblance is discovered. Russell's statistics of stocks on the first of each month average about 75 per cent of the total output of the previous month, and in only 3 out of 51 months have risen above 82 per cent or fallen below 67 per cent of the output for the previous month. More concretely, Russell's statistics of flour stocks represent, with only a few minor exceptions, the flour output of the previous 20 to 25 days.[1]

It appears, therefore, that the two series of statistics of flour stocks currently compiled represent stocks of flour in certain primary commercial hands, better regarded not as *stocks* but as a *cross section of a stream* of

[1] It should be noted that the correspondence between Russell's estimates of flour stocks and the output of the previous month results in part from the fact that about half of Russell's total represents an estimate based directly on his estimate of the flour output for the previous week. The facts may best be described by quoting from a letter from Mr. Russell, dated November 18, 1924. He says, in part, that the figures on flour stocks are obtained by "a formula which I built up at the Grain Corporation when we had all the information that was available. There is no way of obtaining the stocks in the hands of dealers and bakers, and I never have attempted to estimate it. . . . . In addition to the items of New York stocks and [the Chicago *Daily Trade*] *Bulletin's* stocks, an estimated total of mill holdings and transit holdings is given. This is a percentage figure. It was found as a result of three years' experience that the amount of flour in mill stocks and warehouses unshipped was about 137 per cent of the week's output, while the transit stocks averaged about 60 per cent of the week's output. In periods of traffic congestion the transit stocks were very much larger, but eliminating the periods of congestion, we found these figures were approximately correct.

"We obtained from the mills at the Grain Corporation their figures of transit stocks by having them report the amount of sight draft flour and arrival draft flour outstanding at the end of each week. Of course, it was only the big merchant mills that did business outside of their own local territory.

"On the basis of this theory, which we found to be the most reliable we could work out at the Grain Corporation, I have continued to estimate the flour stocks. As there has been no period of traffic congestion the last year or two, the figures are possibly as near correct as can be devised, unless it would be possible for the Census Bureau to obtain each month a statement from the mills of their mill holdings and of their transit holdings."

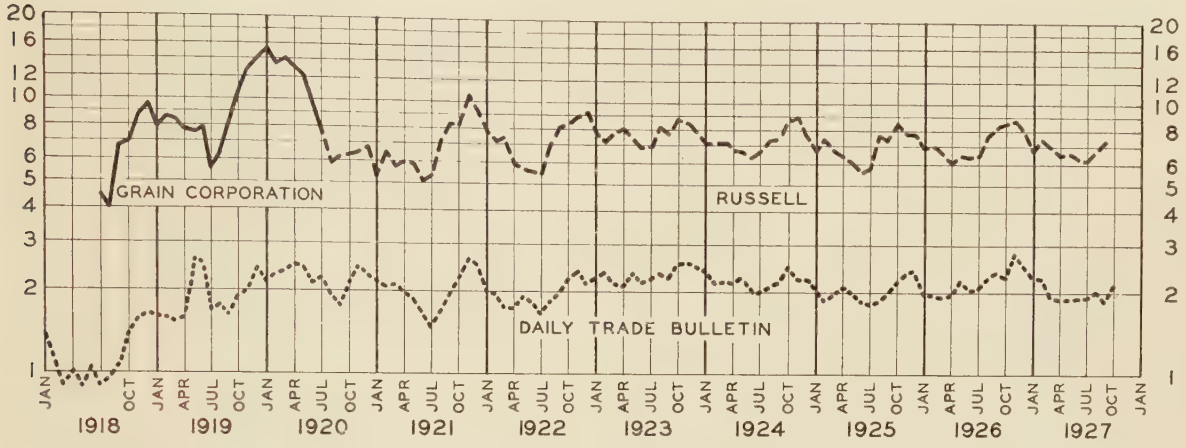
In the text we have examined Russell's figures, without qualification, first because they are widely used and constitute the most comprehensive available series, and second, because we believe them satisfactorily to reflect the changes in commercial stocks. Russell's judgment is worthy of confidence, and comparison of his series with the *Daily Trade Bulletin's* series reveals the same general type of movement, as noted in the text. The reports of mill stocks compiled by the Department of Commerce for June 30 and December 31, 1925, and quarterly since the latter date, also reveal the same type of movement, so far as one can judge from the eight cases thus far available for study.

flour flowing from the mills into secondary commercial hands or into export, and varying in size with the output of the mills. The analogy is worth pushing farther, for while the primary commercial stocks are to be regarded as measuring the volume of a stream, the series representing total stocks is to be regarded as measuring the level of a lake into which the stream flows. The level of the lake continues to rise after the flow in the stream has reached its highest stage and begun to subside, the highest level of the lake being reached, in fact, only when the flow in the stream has decreased to the point of just equaling the rate of discharge from the lake. Similarly, the level of the lake does not reach its low point when the stream is at its lowest stage, but continues to fall until the rate of inflow has increased sufficiently to equal the rate of discharge from the lake.

While the statistics of primary commercial stocks have in recent years shown no evidence of including speculative accumulations varying with the prospects for flour prices, the series compiled first by the Grain Corporation and continued by Russell shows such accumulations during 1919 and 1920 (Chart 6). This was undoubtedly largely a temporary phenomenon, but it may well be that there was more tendency toward speculative accumulation of flour in primary commercial hands under favorable conditions before the war than is observable in recent years. It should be noted, however, that the *Daily Trade Bulletin* series shows no such accumulation, even in 1919 and 1920.

CHART 6.—MONTHLY MOVEMENT OF COMMERCIAL FLOUR STOCKS AS REFLECTED IN TWO STATISTICAL SERIES SINCE 1918*

(Million barrels)



* When plotted on a logarithmic vertical scale, showing *relative* changes in their correct proportion, the statistics of flour stocks compiled jointly for many years by the Chicago *Daily Trade Bulletin* and the Minneapolis *Daily Market Record* show much the same general characteristics as the more comprehensive series compiled by the Grain Corporation and continued by Russell. Both are closely related to the mill output of the previous month, and, with the exception of the Grain Corporation series in 1919 and 1920, include no appreciable speculative accumulations at any time. In both respects the two series of commercial stocks contrast sharply with the series representing changes in total flour stocks. (See Chart 2, p. 66, and Chart 5.)

CHARACTERISTICS OF CHANGES IN TOTAL FLOUR STOCKS

Returning to a consideration of the curve of total flour stocks, as shown in Chart 5, it appears that the lowest first-of-the-month stocks have uniformly occurred either in July or August. The July 1 level is in each case about 3 million barrels under the 4-year average for all months, and is much more nearly uniform than the August 1 level, showing a range of variation considerably less than one million barrels in the five July's covered by the figures. The level of flour stocks on August 1 has sometimes risen above the July 1 figure, and sometimes fallen considerably below it, apparently depending chiefly on the movement of the winter-wheat crop.

In each of the first four years covered by the figures, stocks increased considerably between the first of August and the first of September, and still more in the next two months, reaching nearly the same levels, about 5 million barrels above the July 1 figure, on the first of November. A slight further rise occurred each year to December 1. In 1927, however, total flour stocks showed no increase between August 1 and September 1 and only a moderate increase to October 1. The November 1 figure, the latest available as we go to press, is over 3 million barrels below the figure for any of the four previous November's.

From December 1 to March 1, there is a wide diversity in the movement of stocks, the January 1 levels varying through a range of nearly 2 million barrels, and the March 1 stocks showing a range of over 3 million barrels.

The normal course seems to be for total flour stocks to reach their peak about December 1, and thereafter to decline, at first slowly, then more rapidly, to the low levels of midsummer, 5 or 6 million barrels under the high point of the early winter. This normal course seems to be subject to a wide variation, however, depending largely on the general opinion as to the probable future of wheat and flour prices. In the winter of 1924–25, the general fear of a serious shortage of wheat and of still higher prices later led to heavy accumulation of flour stocks, continuing into February or March. In the winter of 1925–26, a somewhat similar situation led to much the same results, despite the painful lesson of the previous year. With the fear of shortage less acute, an earlier decline in prices, and probably some influence from the experience of the year before, stocks were maintained at high levels through the winter, but not increased materially above the level of December 1.

The abnormally low levels of flour stocks in the months beginning with August 1927 are clearly to be attributed in large measure to the downward tendency in wheat prices which began in June and continued with little interruption through October. It may be significant, also, as a further indication of the influence of opinions regarding the future of wheat and flour prices, that in the fall and early winter of 1923–24 flour stocks remained somewhat below the levels for corresponding dates in the next three years. Beginning in September of that year, wheat prices moved uncertainly up and down, through a considerable range, but without definite trend, except that for spring wheat the declines were generally larger than the advances. This situation probably tended to restrict the accumulation of stocks. The fact that prices of the better milling wheats were considerably above Canadian prices may have had some influence also.

It should be noted, however, that the amount by which the stocks figures from October 1 to December 1 of 1923 differ from the figures for corresponding dates in subsequent years is within the limits of the possible errors in the data, and the evidence of unusually low stocks during this period may be spurious. None of the other characteristics of the stocks curve thus far noted is subject to such suspicion.

Conclusions

Summarizing and generalizing on the basis of the foregoing detailed discussion of flour stocks, it appears first of all that the statistics of flour stocks which have been compiled in past years are in no way representative of changes in total flour stocks. They include a small portion of the total, representing a class of stocks which varies quite closely with the mill output during the previous month and gives no reliable indication of the amount or even the direction of the changes in total flour stocks.

The period of only a little over four years for which we have derived monthly figures reflecting the changes in total flour stocks is relatively short, and the data are subject to certain limitations, so that generalizations must be drawn with caution. It appears clear, however, that total flour stocks on the first of January, the beginning of the calendar year, are subject to wider variations from year to year than total flour stocks on the first of July, the beginning of the crop year for the United States. The level of total flour stocks on January 1 is materially affected by opinions regarding the probable future course of wheat and flour prices. The period covered seems probably to include nearly the extreme range of conditions influencing the level of

January 1 stocks, with the exception of such extraordinary conditions as obtained during the war period. In consequence, it seems probable that changes in the level of flour stocks between the beginning and the end of a calendar year seldom, if ever, exceed 2 million barrels, except under such extraordinary conditions as obtained during the war and the immediate post-war period. Under such conditions, the changes may be several times as great.

An incidental conclusion of considerable interest to millers follows as a corollary of the foregoing statements. Since the level of flour stocks in the winter months is largely dependent on conditions influencing the disposition of buyers to accumulate flour stocks, the rate of milling activity must also be dependent on the same conditions. Variations in the amount of forward buying must have some influence also, leading to variations in mill stocks held against such orders. The recent Department of Commerce statistics of mill stocks, however, suggest that such accumulations must be small in comparison with other accumulations, so that the influence of forward buying on milling activity must be much less than the influence of actual accumulations of stocks by buyers.

IV. ANNUAL FLOUR CONSUMPTION, 1879–1917

In previous numbers of WHEAT STUDIES, we have pointed out the fact that the general trend of flour consumption in the United States may be determined very closely from calculations of domestic disappearance in census years.[1] We have shown further that all the available evidence points to the conclusion that, except under such extraordinary conditions as prevailed during the war, actual per capita consumption seems to change very little from year to year, except in periods of change of consumption habits, during which the change must be gradual and relatively uniform. In consequence, a curve showing the trend of flour consumption prior to the war may be regarded as representing the actual consumption in each year almost as accurately as it represents the level and trend of consumption over a period of years.

The calculation of the trend of flour consumption may be made with considerably greater accuracy by supplementing the statistics of flour disappearance in census years with estimates of changes in total flour stocks between the beginning and the end of each census year, thus obtaining a closer approximation to the actual consumption in those years. The facts brought out in the study of changes in total flour stocks (pp. 79–81, above) throw light on the amount of change to be expected under special conditions, which, taken in connection with the conditions obtaining in each year, permits of very fair estimates of the changes in flour stocks which occurred in those years. In consequence, it becomes possible to calculate the trend of flour consumption for pre-war years with greater confidence in the results than has previously been possible.[2] As thus obtained, the estimates of annual flour consumption between 1879 and 1917 appear to be probably within 1 per cent of the facts for each year, with the possible exception of a few years between 1900 and 1917 when consumption habits were changing rapidly and perhaps with sufficient irregularity to result in actual consumption in occasional years as much as 2 or 3 per cent above or below our estimates.

FLOUR DISAPPEARANCE IN CENSUS YEARS

The basic data for calculating the trend of flour consumption, prior to the war period, are furnished by the statistics of domestic disappearance in census years. The statistics for each census year since 1879 are given in Table 3 (p. 86). In making the calculations we have taken the census reports of total flour output, adding to the reported figures for quinquennial and biennial censuses an estimate of the production of custom mills, omitted in those censuses. For these estimates we have followed the method employed by the Department of Agriculture in a similar computation two

[1] "Wheat Acreage and Production in the United States since 1866," June 1926, II, 240–41, and "The Decline in Per Capita Consumption of Flour in the United States," July 1926, II, 267–74.

[2] For example, in the studies just cited.

years ago,[1] estimating the output of custom mills in 1904 and in 1914 at the figure shown by the census of 1909, namely 1,351,816 barrels, and in 1921, 1923, and 1925 at the figure shown by the census of 1919, namely 1,205,068 barrels. In three respects we have departed in the subsequent calculations from the method employed in the Department of Agriculture compilation, the results of which we have previously used: we include shipments of flour to possessions of the United States as well as exports; we take account of flour shipped to the American Expeditionary Forces, the American Red Cross, and the Northern and Southern Relief organizations, none of which is included in the Department of Commerce export statistics; and we take no account, at this stage, of changes in flour stocks. The need for including the additional statistics of flour shipped out of the United States is obvious. The statistics of stocks are neglected because we have found that the existing statistics cover a class of stocks not at all representative of the changes in total stocks of flour.

Flour Stocks in Census Years, 1879–1914

Although the available statistics of flour stocks are of no value as an indication of the change in total flour stocks between the beginning and the end of each census year, useful estimates of these changes may be made on the basis of a study of the conditions obtaining in each year. The estimates cannot be highly accurate, but even if they are all in error by 50 per cent, their use will reduce by one-half the existing errors from this source in the calculated flour consumption.

The method of procedure to be followed in the subsequent paragraphs may be outlined briefly at the outset. Taking each census year separately, we note first the level and course of wheat prices during the six months preceding the beginning of the year and the six months preceding the end of the year, giving attention to any circumstances which appear likely to have influenced the level of flour stocks on January 1 and on December 31. Judging the results to be expected from these circumstances, in the light of the facts developed in the foregoing study of flour stocks, we estimate the probable direction and amount of the change in flour stocks during the year, expressing the amount qualitatively as negligible, moderate, or large. A check on these preliminary estimates is then obtained through the fact that unusually large or unusually small accumulations of stocks must be reflected in the rate of milling activity (due regard being paid to the influence of export demand) and in the tone of the flour market. Information on milling activity and on market conditions is collected for each year from contemporary trade publications. As it turns out, the available records of milling activity and market conditions in each year point to substantially the same conclusions as are reached from the study of the price movements and related conditions.

Finally, we crystallize the judgment of probable change in stocks into a quantitative estimate, to the nearest half-million barrels. For this purpose we assume that a "large," but not extraordinary, change in stocks is to be set at about 2 million barrels, under present conditions, and at about 1 million barrels under the conditions obtaining in the earliest years of the period under review. The evidence developed in the study of flour stocks would justify the use of somewhat higher figures, but it is safer to keep the estimates conservative.

The calendar year 1879 was preceded by two and a half months of very stable prices, following a decline of 20 cents between the middle of August and the middle of October. It ended with a period of rising prices, including a rise of 30 cents between the first of September and the middle of October, followed by decline of a little over 5 cents in the next three weeks and then another steady upward swing amounting to over 15 cents between the second week of November and the end of December. The relation of spot wheat to the December option was practically the same in the months preceding the beginning and the end of the year. These circumstances point to a moderate increase in flour stocks at the end of the year as compared with stocks at the beginning of the year.

The reports of activity in the milling industry and the flour trade, as published currently in the Chicago *Daily Commercial Bulletin,* indicate that production of flour

[1] *Wheat and Rye Statistics,* Table 85.

during the fall and early winter of 1879, while only moderately active, was considerably above that of the same period one year earlier. In summarizing the year's trade, the *Bulletin* states:[1]

> Trade for the past year has been quite satisfactory, and although not really active, it is gratifying in reviewing the market to note an increase in the aggregate business transacted and the movement in general. The usual intervals of dullness existed, but generally the movement was satisfactory. The receipts for the year show the production to have been unusually large—the arrivals for the past year exceeding the receipts of the previous year some 300,000 barrels, all of which increase occurred since September, or since the new wheat crop commenced to move. Millers, stimulated by prospects of high prices and the reported shortage of the crops of the world, have run their mills pretty well to their full capacity when able to do so.

While the indications all point to a substantial increase in flour stocks between the beginning and the end of the calendar year 1879, it must be borne in mind that the total annual flour output at this time was little over half that of recent years. In view of the state of development of the flour trade at the time, it appears probable that the increase in flour stocks amounted to something like half a million barrels.

The calendar year 1889 was preceded by a rise of 20 cents in wheat prices between the end of July and early October. A corner was run in September wheat at Chicago, but apparently had little influence on the subsequent course of prices. Prices remained fairly steady through October, at $1.10 to $1.20 for contract wheat at Chicago, but in early November a decline set in, carrying prices down about 15 cents by the end of December. The year ended with seven months of very stable prices, the price of contract wheat at Chicago remaining throughout between 75 and 85 cents, but showing a slight tendency to decline. The relation of spot wheat to the December and May futures in Chicago was very similar in both periods. The price situation was therefore such as to indicate that flour stocks at the end of the year must have been somewhat larger than at the beginning of the year.

The reports of milling activity published currently during the months preceding the opening of the calendar year reflect active milling and accumulation of stocks by consumers during the period of rising prices in September, but in early October purchases were sharply curtailed, the market being described as "demoralized." Throughout the remainder of the year the demand was recorded as "very light" and "extremely dull." In the corresponding months preceding the end of the calendar year there was no period of unusual activity, but apparently a fair volume of milling, for the season, throughout. This record indicates that early in the season preceding the opening of the calendar year, flour stocks were built up to fairly high levels, and then allowed to decline. Apparently they had reached very low levels by January 1, for during January it was remarked that the demand was improving despite a further decline in wheat prices. At the end of the crop year flour stocks were probably about normal. Some increase in flour stocks clearly occurred between the beginning and the end of the calendar year, probably amounting to something like half a million barrels.

The calendar year 1899 was preceded by five months in which prices remained close to 65 cents a bushel for contract wheat at Chicago, though with a slight tendency toward advancing prices. Cash wheat sold most of the time on a par with the December future, though prior to the end of September it showed a small premium. During the months preceding the end of the year, wheat prices moved through practically the same range as during the corresponding period one year earlier, but with a pronounced downward tendency after late September. Between the end of September and the first of December the decline, though very gradual, had amounted to nearly 10 cents. The relation of cash wheat to the futures was nearly normal throughout the period. The price trends were therefore such as to induce less accumulation of flour stocks prior to the close of the year than were carried into the year. The difference in premiums on cash wheat in the two periods was so small as probably to exert little influence.

The record of milling activity in 1899 shows milling generally very active, for the season, throughout the five months preceding the opening of the year. The corre-

[1] December 31, 1879.

sponding period preceding the close of the year was also a good one for the mills, but periods of dullness were more frequent and more pronounced, and there was never the enthusiasm over conditions which had prevailed during much of the earlier season. It seems quite clear that flour stocks were reduced during the year, probably by about half a million barrels.

The months preceding the opening of the calendar year 1904 were characterized by considerable irregularity in wheat price movements and diversity in the movements for different classes of wheat. There were no extended periods of general weakness or strength which might have materially affected the disposition to accumulate flour stocks, but the relatively low level of prices was favorable to the carrying of liberal stocks of flour. During the months preceding the end of the crop year, wheat prices averaged about 30 cents a bushel above the level of prices one year earlier. After a sharp rise during August, prices remained fairly steady, but with an upward tendency on the whole. Conditions were therefore again favorable to the accumulation of liberal supplies of flour.

The record of milling activity and general market conditions during these two periods is particularly difficult to interpret in terms of its bearing on the accumulation of flour stocks, owing to the great difference in the export demand in the two periods. During the six months July to December 1903, over 10 million barrels of flour were exported, while in the same months of 1904 exports amounted to only 4.7 million barrels. In consequence, milling activity, in the aggregate, was considerably less in the latter period. The current comments bearing on the domestic demand indicate active purchasing for domestic use in both periods, such as would have led to the accumulation of liberal stocks of flour, at about the same levels, by the beginning and by the end of the calendar year 1904. This is in agreement with inferences from the price situation in the two periods, and we therefore assume no significant change in flour stocks between the beginning and the end of this calendar year.

In the months preceding the beginning of the calendar year 1909, wheat prices moved quite steadily upward, prices of contract wheat in Chicago rising 20 cents between the first of July and the first of January. The relation of spot wheat to the futures was normal throughout the period. Stocks of flour must have been somewhat above normal by the first of January. In the months preceding the end of the year, prices of contract wheat in Chicago moved up by about the same amount as in the corresponding period one year earlier, but following a quite different course, most of the increase coming in September, followed by steady prices until December, when a slight further increase occurred. Throughout the fall and early winter, No. 2 Red Winter wheat in Chicago was at a heavy premium, ranging mostly between 10 and 15 cents, over the December and May futures, but spring wheat was at only a slight premium.

The reports published currently by the *Northwestern Miller* show flour output for the crop year to January 1 slightly higher in the Northwest in 1909 than in 1908, but elsewhere the output appears to have been considerably lower in 1909. Exports of flour for the same periods were half a million barrels less in 1909 than in 1908, compensating in part for the decreased output. The reports of output, therefore, seem to support the conclusion, indicated by the price situation, that flour stocks were reduced slightly during 1909, probably by something like half a million barrels.

In the months preceding the calendar year 1914, wheat prices showed a very slight upward tendency, but spot wheat of contract grades in Chicago remained almost continuously at a premium over the December future, part of the time at a premium over the May future. In July and August preceding the end of the calendar year, prices rose 40 cents a bushel, declined about 15 cents during September, and then rose fairly steadily to the end of the year. The relation of spot wheat to the futures was normal throughout these months. The price conditions were thus such as to lead to low stocks at the beginning of the calendar year and unusually high stocks at the close of the year. A further tendency toward high stocks at the end of the year was furnished by the fears engendered by the outbreak of the war in Europe.

The reports of milling activity published by the *Northwestern Miller* and the *Daily*

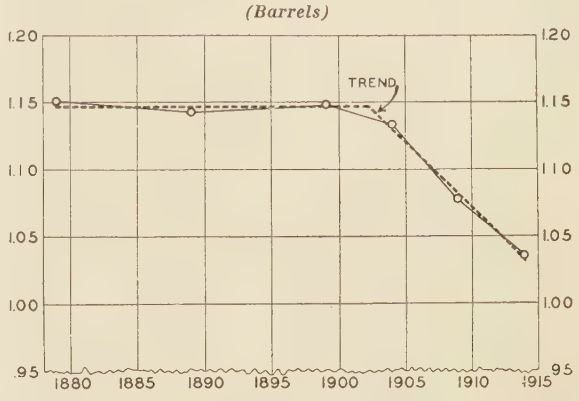
Trade Bulletin are in entire agreement with these conclusions. Flour output from August to December 1914 in the Northwest spring-wheat region was slightly under that of the same months in 1913, but elsewhere, especially in the hard winter-wheat districts, the output was greatly increased. Exports, on the other hand, were only slightly larger in these five months of 1914 than in the same period of 1913. Altogether, it appears that total flour stocks must have increased by 2 million barrels between the beginning and the end of the year 1914.

Trend of Flour Consumption

The foregoing estimates of changes in total flour stocks between the beginning and the end of each census year from 1879 to 1914 are brought together in one column of Table 3 (p. 86) and form the basis for calculating the approximate actual consumption from the total disappearance in each census year from 1879 to 1914. For later census years, the estimates of consumption are derived by another method, described in the next section, and the changes in stocks shown in the table for these later years are the changes necessary to harmonize the calculated disappearance with the estimated consumption.

The calculated flour consumption in each census year from 1879 to 1914, reduced to barrels per capita, is shown in Chart 7. The vertical scale in this chart is much exaggerated to facilitate a closer study of the changes in flour consumption. Study of the chart leads to raising the question whether the trend of flour consumption is properly to be represented by a smooth curve showing a decline which started slowly between 1890 and 1900 and gradually gained momentum, or by two fairly distinct trends representing a period of substantially stationary consumption per capita, merging rather sharply into a period of declining per capita consumption. On general grounds, it appears much more reasonable to assume that the decline in per capita consumption of flour started gradually and that the trend should be represented by a smooth curve, approximately horizontal in the early years and gradually turning downward with a steadily increasing slope. While the data do not accord with this theory, they cannot be said to clearly disprove it, for they could be brought into line by assuming that the calculated consumption figures for 1899 and 1904 are about 1 and 1½ million barrels, respectively, above the actual consumption in those years. Such errors are not impossible,[1] and it is advisable, before accepting the evidence of a fairly abrupt change in the trend of per capita consumption, to investi-

Chart 7.—Apparent Per Capita Consumption of Flour, 1879–1914*



* The data for apparent flour consumption are obtained from the census statistics of total output (raised, for other than decennial censuses, by estimates of output of custom mills) by subtracting the net exports and shipments to possessions, and then adjusting with estimates of changes in flour stocks between the beginning and the end of each census year. (See Table 3, p. 86.) Per capita consumption among many classes of the population began to decline early in the period, but the substitution of flour for corn meal by other classes, taking place most rapidly between 1897 and 1902, kept the general average rate of consumption practically constant until shortly before 1904. Thereafter, per capita consumption declined nearly 1 per cent a year up to 1914 at least, probably until the further sharp decline following our entry into the war.

[1] The consumption figures are of course affected by our estimates of changes in flour stocks. In view of the degree to which these estimates represent judgments with a somewhat intangible basis, the question may well be raised whether we have not allowed our judgment to be swayed by preconceptions of the results which should come out of the figures. We have of course made every effort to avoid any such warping of our judgments, and indeed the evidence in most years admits of less difference of opinion regarding the direction and amount of change in flour stocks than may appear to the casual reader. The year 1904 presented the most difficult problem of any in the period under review. It may be noted, however, that the judgment that flour stocks did not change appreciably between the beginning and the end of 1904 was reached at a time when we still held the view that the trend of per capita consumption should be represented by a smooth curve throughout. It was only after we had fixed on the figure for approximate consumption of flour in 1904 that we were led to the further investigation which culminated in the conclusion that per capita flour consumption must have suffered a fairly abrupt change of trend at about that date.

gate the conditions influencing flour consumption during this period.

The downward trend of flour consumption, up to 1914 at least, was a composite result of at least three different tendencies, two of which worked in opposite directions. First among these was a fairly general tendency toward the eating of less food, resulting perhaps chiefly from a decrease in the amount of physical effort required of the average individual. Second, there was a tendency, also fairly general, to substitute other food, chiefly sugar, in place of bread. Third, there was a pronounced shift from corn meal to flour, chiefly among the population of the South.[1] The decline in consumption of corn meal, as indicated by the figures of distribution in census years, was much greater between 1899 and 1904 than between any other two census years. A ready explanation is found in the fact that the tendency to shift from corn meal to flour, which had been in operation for some years, was accelerated in this period, especially in 1902 and 1903, by unusually high prices of corn meal, coupled with low prices of flour.[2]

It seems quite clear, therefore, that while there was undoubtedly a considerable decline in flour consumption among many classes of the population between 1899 and 1904 there was also an uncommonly rapid replacement of corn meal by flour in the diet of other classes in this same period. The decrease in apparent annual consumption of corn meal between 1899 and 1904 amounted to 27 pounds per capita for the entire population of the United States, a decline of such magnitude that the replacement of the corn meal by flour would have offset a very substantial curtailment of flour consumption on the part of other groups of the population.

With this information as to influences at work, it is evident that the trend of per capita flour consumption cannot be described by any single curve fitted by the method of least squares to the data for the entire period from 1879 to 1914. The best alternative is to represent the trend by two

TABLE 3.—PRODUCTION AND APPARENT DISPOSITION OF FLOUR IN THE UNITED STATES BY CENSUS YEARS, 1879–1925*

(Thousand barrels)

Census year	Production as reported	Unreported production (estimated)	Total production	Imports	Total supply excluding stocks	Exports, re-exports, and shipments	Domestic disappearance	Change in stocks	Estimated total consumption	Per capita consumption (bbl.)
1879.....	62,840	.....	62,840	15	62,855	6,134	56,721	+ 500	56,221	1.151
1889.....	80,949	.....	80,949	1	80,950	10,451	70,499	+ 500	69,999	1.142
1899.....	103,524	.....	103,524	1	103,525	18,717	84,808	— 500	85,308	1.148
1904.....	104,013	1,352	105,365	26	105,391	11,928	93,463	0	93,463	1.133
1909.....	107,108	.....	107,108	113	107,221	10,212	97,009	— 500	97,509	1.077
1914.....	116,404	1,352	117,756	79	117,835	13,286	104,549	+ 2,000	102,549	1.036
1919.....	133,671	.....	133,671	17	133,688	29,826	103,862	+10,762	93,100	.893[a]
1921.....	110,846	1,205	112,051	966	113,017	17,363	95,654	— 1,446	97,100	.896
1923.....	114,439	1,205	115,644	268	115,912	16,934	98,978	— 1,622	100,600	.902
1925.....	114,690	1,205	115,895	11	115,906	11,714	104,192	+ 392	103,800	.902

* The reported production figures are the census totals, to which are added, for quinquennial and biennial censuses, estimates of the output of custom mills, taken for 1904 and 1914 as equal to the output reported in 1909, and for 1921–25 as equal to the output reported in 1919. The imports, exports, and shipments to possessions are from publications of the Bureau of Foreign and Domestic Commerce, to which are added in 1919 the Grain Corporation statements of shipments to the American Expeditionary Forces, American Red Cross, and Northern and Southern Relief, totaling 2,755,400 barrels. Changes in stocks are independently estimated for the years 1879 to 1914 (see pp. 82–85) and the indicated consumption computed by subtracting the estimated changes in stocks from the domestic disappearance. For the years 1919 to 1925 the consumption is estimated independently (see pp. 90 f.) and the indicated changes in stocks computed.

[a] Expeditionary forces excluded from population estimate.

[1] Cf. "The Decline in Per Capita Consumption of Flour in the United States," WHEAT STUDIES, July 1926, II, 286–87.

[2] A ready comparison is available in the figures compiled by the Bureau of Labor Statistics on wholesale prices of both commodities in New York City. The average wholesale price of flour in this market in 1897 was $4.59 a barrel or $2.34 per 100 pounds, while the price of fine white corn meal averaged $.82 per 100 pounds. In 1902 the corresponding prices were $1.94 and $1.54 per 100 pounds, making corn meal 2¼ times as expensive, relative to flour, in 1902 as in 1897.

separate curves, one for the period 1879–1904, the other for the period 1904–1914. The information from which the form and position of the two curves must be determined is so limited that use of anything more complicated than straight lines is not justified. These lines, shown on Chart 7 (p. 85) have been obtained by assuming a horizontal trend for the earlier period, at the level indicated by the average for the three census years, 1879 to 1899 inclusive, and joining this with a straight line fitted by the method of least squares to the data for the three census years 1904 to 1914 inclusive.[1]

Flour Consumption by Crop Years

The rate of flour consumption per capita for each crop year from 1879–80 to 1916–17, as indicated by the trend, is readily calculated. Multiplying the per capita figures by the estimates of the population of the United States as of the middle of each crop year gives the estimated total flour consumption for each year shown in Appendix Table 1, and graphically in Chart 1 (p. 65). The calculation of domestic flour consumption on the basis of these trends cannot be applied to any of the period subsequent to about midsummer 1917, since the activities of the Food Administration profoundly affected the rate of flour consumption shortly after its organization.

The total annual consumption shows a rapid increase from 1879 to 1904, proportionate to the increase in population of the United States. After 1904 the rate of increase is slightly reduced, the natural effect of the growth of the population on total consumption being partially offset by the downward trend of per capita consumption.

V. ANNUAL FLOUR CONSUMPTION SINCE 1917

Peculiar Problems of the Period

The method of estimating annual flour consumption outlined above cannot properly be applied to the period of American participation in the war, and for a time thereafter when conditions were quite abnormal, and it is important to know as accurately as possible what changes in flour consumption occurred during these years. Additional data are available to throw light on the problem, chiefly from the compilations of the Food Administration and of the United States Grain Corporation and the estimates of flour production prepared by A. L. Russell, formerly statistician for the Grain Corporation. Taken by themselves, these data point to conclusions which seem difficult to accept, but when they are closely analyzed in connection with related information a very clear picture is obtained of the changes in flour consumption since 1917, forming the basis for estimates of domestic flour consumption between 1917–18 and 1923–24, which are probably within 1 per cent of the facts for each year.[2]

The most noteworthy feature of the results is the conclusion that flour consumption in the United States was reduced over 10 per cent during the last six months of 1917 and has not since risen appreciably above the level of about nine-tenths of a barrel per capita reached at that time. The figures that we had accepted previously, based on a calculation of flour disappearance derived from census statistics of production, indicated that the present low level of per capita consumption was not reached until 1920 or 1921.[3]

The major difficulty in determining the course of flour consumption during and after the war is raised by the figures covering the two crop years 1918–19 and 1919–20 and the calendar year 1921. These show an extraordinary variation in domestic disappearance of flour, the 12-month totals being respectively 92.9, 108.4, and 95.6 million barrels. The statistics are not open to the suspicion of error, except in negligible degree. The disappearance for 1918–19 and 1919–20 is calculated from the very complete statistics of output collected by the Grain Corporation during this period, raised

[1] The equations for the two curves are respectively $y = 1.147$ and $y = 1.131 - 0.0097t$ where y is consumption in barrels per capita, and t represents time, measured in years, with 1904 as the origin.

[2] The estimate for 1917–18 is open to more question than any of the others and may be somewhat more than 1 per cent above or below the facts.

[3] "The Decline in Per Capita Consumption of Flour in the United States," Wheat Studies, July 1926, II, 266–74.

by 1,337,000 barrels in each year, the difference between the Grain Corporation total for 1919 and the census total for the same year. The figure for 1921 is calculated from the output reported by the census of 1921, raised by 1,205,000 barrels to include the output of custom mills.

It is not unreasonable to suppose that flour consumption increased after the armistice; but that the consumption could have increased 17 per cent in 1919–20 over that in 1918–19 (only a little over one-third of the earlier period falling before the armistice), and then after an interval of only six months declined 12 per cent, is beyond belief. Clearly there must have been some extraordinarily large changes in flour stocks between the beginning and the end of some or all of these 12-month periods. Conditions were so abnormal during these years, however, as to leave little ground for estimating the changes in flour stocks. Instead of attempting to deduce actual consumption from the disappearance, together with estimates of changes in flour stocks, we proceed by assembling other information as a basis for preliminary estimates of consumption and checking these by examining the reasonableness of the changes in flour stocks which must be assumed to harmonize all the data.

Preliminary Estimates

The trend of flour consumption since 1923–24, as calculated in an earlier section (p. 75), may be regarded as representing the facts for these later years very accurately. There is ground for supposing that this trend represents a continuation of the trend in earlier years. Assuming that the trend of flour consumption calculated for the years 1923–24 to 1926–27 may be extended back to 1921, and checking this assumption against the flour disappearance in 1923, using the census production raised by the estimate for custom mills, it appears that the two are in perfect agreement, if allowance be made for a decrease of about a million barrels in flour stocks during the year 1923. That approximately this decrease actually occurred seems highly probable. It has already been shown (p. 80) that total stocks of flour on January 1, 1924 were appreciably below the average for that date in recent years, while the trend of prices prior to January 1, 1923 had been such as to favor the accumulation of liberal stocks.

A similar calculation for 1921 shows that allowance must be made for a decrease of 2 million barrels in flour stocks to bring the disappearance figures into agreement with the assumed rate of consumption. This is not so clearly reasonable. Prices fell sharply in the months preceding the opening of the calendar year 1921, with premiums for cash wheat at times fairly high. Prices were still declining, but less rapidly, in the months preceding the end of the year, and the relation of cash prices to the futures was nearly normal. These conditions suggest an increase in flour stocks between the beginning and the end of 1921.

It is entirely possible, however, that stocks at the beginning of the year were higher than might be expected from the course of prices during the preceding months, owing to the presence in some quarters of supplies still on hand from exceptionally large accumulations of the previous winter and spring. Furthermore, the wheat market during the fall and early winter was a peculiar one. Although prices declined 80 cents a bushel between August and December, the decline occurred entirely in two short separate periods. Between the end of July and the middle of September prices rose. An almost uninterrupted decline of over 50 cents a bushel during the next three weeks was followed by a month in which prices, though fluctuating, remained above the low point of the decline. Then came another decline of 50 cents a bushel, followed by a reaction of 15 cents, to a level at which prices remained firm throughout the month of December. Though the period was superficially one of sharply declining prices, it appears on closer analysis that major declines were in progress during less than one-third of the time between the first of August and the last of December. During over two-thirds of the time, the market was steady or rising. During each of the three extended periods of steady or rising prices, current prices appeared low by comparison with those of the previous year. There may, therefore, have been, through most of the time, a disposition to maintain flour stocks at approxi-

mately normal levels. On this interpretation, it appears quite reasonable to suppose that stocks at the beginning of the year were 2 million barrels above the level reached at the end of the year.

Since the assumption appears tenable that the trend of flour consumption over the last four years may be extended two and a half years farther back, it is worth trying the experiment of extending the same trend back through the war period, with certain modifications which are obviously necessary. This implies the assumption that per capita flour consumption has never recovered from the curtailment induced during the war. A good argument can be made, on theoretical grounds, for this contention.

Very good statistics are available for checking this theory. The primary requisite is a record of flour output over the three and a half years, July 1, 1917 to January 1, 1921. For two of these years, 1918–19 and 1919–20, we have the highly trustworthy and complete compilation of the Grain Corporation, already discussed. These, however, need to be raised by 1,337,000 barrels for each year, the difference between the Grain Corporation total and the census total for 1919. For the crop year 1917–18, Russell's estimates may be used with considerable confidence. They represent estimates with a strong basis in the extensive data compiled currently by the Grain Corporation and checked as to level by the practically complete data compiled through the next two years, and by the census of 1919.

For the six months July–December 1920, Russell's estimates may again be used, but here an adjustment is required. Beginning with July 1920, Russell was forced to take as the basis for his estimates the relatively incomplete data compiled by the *Northwestern Miller*, introducing a considerable opportunity for error. In each census year since that date, Russell's estimates of mill output have been close to 10 million barrels above the output indicated by raising the census figures by the amount of the output of custom mills in 1919. It seems probable, therefore, that Russell's estimate of flour output during the last six months of 1920 is too high by half the amount of his overestimate of the output during the 12 months of 1921. We therefore estimate the output for this 6-month period at 4.59 million barrels below Russell's figure, or 50,880,000 barrels

Making use of these data, we may calculate the domestic disappearance of flour by 6-month periods, beginning with July 1917. The resulting figures are shown in the third column of Table 4. To make the comparison more complete, we have added figures for the two halves of 1921, obtained by allocating the output shown by the census, plus the estimate for custom mills, between the two halves of the calendar year in the ratio shown by Russell's estimates.

TABLE 4.—PRELIMINARY TABULATION OF OUTPUT AND DISPOSITION OF FLOUR BY 6-MONTH PERIODS, JULY 1917—DECEMBER 1921*

(Million barrels)

Period	Output	Net exports and shipments	Disappearance	Estimated consumption	Change in stocks	
					During period	Since July 1, 1917
1917						
July–Dec...	66.64	7.68	58.96	49.00	+ 9.96	+ 9.96
1918						
Jan.–June..	48.75	15.26	33.49	46.00	—12.51	— 2.55
July–Dec...	62.90	9.96	52.94	46.00	+ 6.94	+ 4.39
1919						
Jan.–June..	59.56	19.61	39.95	46.50	— 6.55	— 2.16
July–Dec...	74.11	10.20	63.91	47.57	+16.34	+14.18
1920						
Jan.–June..	56.32	11.94	44.38	47.94	— 3.56	+10.62
July–Dec...	50.88	7.77	43.11	48.32	— 5.21	+ 5.41
1921						
Jan.–June..	46.36	7.59	38.77	48.70	— 9.93	— 4.52
July–Dec...	65.69	8.81	56.88	49.07	+ 7.81	+ 3.29

* See accompanying text.

In the fourth column of this table are shown the estimates of consumption which are to be checked. They have been obtained by extending backward the trend of consumption obtained for the years 1923–24 to 1926–27, with the following modifications. The value given by the trend is lowered roughly by the equivalent of one-half barrel[1] of flour for each man abroad in the American Expeditionary Forces,[2] for each

[1] Representing roughly the consumption to have been expected had they remained in the United States in their customary civilian occupations.

[2] Data from L. P. Ayres, *The War with Germany* (U.S. War Department, Washington, D.C.), revised edition, 1919, p. 15. The averages by 6-month periods beginning July 1, 1917 are (in thousands) 66, 353, 1,604, 1,384, and 82.

6-month period between January 1918 and June 1919. Shipments of flour to the American Expeditionary Forces have been included with exports. In calculating the disappearance for the last half of 1917 the consumption is placed about midway between the estimated consumption in the first half of 1918 and the estimated consumption in the first half of 1917, the latter derived, as described in the previous section, from the trend of per capita consumption between 1904 and 1914. This is done on the assumption that only half of the final influence of the Food Administration in reducing flour consumption made itself felt during this period.

Tests and Revision of Estimates, 1917–23

The changes in total flour stocks in each half-year necessary to harmonize these consumption estimates with the figures of flour disappearance are shown in the fifth column of Table 4. The changes may be studied more conveniently, however, when cumulated, as shown in the sixth column. This gives the implied total change in flour stocks between the July 1, 1917 and the end of each 6-month period. It is at once apparent that the estimates of consumption harmonize quite well with the statistics of flour disappearance. There is ground, however, for questioning whether flour stocks at the end of June 1921 were really quite 4.5 million barrels below their level on July 1, 1917. Apparently, the estimates of consumption are slightly excessive.

A very slight revision of the trend, involving the assumption that since the war the rate of increase in total flour consumption has been 1⅔ per cent a year instead of about 1½ per cent, as indicated by the trend calculated from the data for the last four years, suffices to bring the estimates of consumption into agreement with the statistics of flour disappearance. The revised figures are shown in Table 5. On a per capita basis they represent a rate of consumption about 1 per cent below the apparent level of per capita consumption in 1927. These results are highly interesting, for they demonstrate the complete agreement of the best available statistics with the theory that flour consumption per capita in the United States has never recovered appreciably from the level to which it fell during the war. The apparent increase of 1 per cent in ten years is within the limits of possible errors in the data.

Table 5.—Revised Tabulation of Output and Disposition of Flour by 6-Month Periods, July 1917—December 1921*

(Million barrels)

Period	Output	Net exports and shipments	Disappearance	Estimated consumption	Change in stocks	
					During period	Since July 1, 1917
1917						
July–Dec...	66.64	7.68	58.96	48.50	+10.46	+10.46
1918						
Jan.–June..	48.75	15.26	33.49	45.50	—12.01	— 1.55
July–Dec...	62.90	9.96	52.94	45.50	+ 7.44	+ 5.89
1919						
Jan.–June..	59.56	19.61	39.95	46.00	— 6.05	— .16
July–Dec...	74.11	10.20	63.91	47.11	+16.80	+16.64
1920						
Jan.–June..	56.32	11.94	44.38	47.52	— 3.14	+13.50
July–Dec...	50.88	7.77	43.11	47.94	— 4.83	+ 8.67
1921						
Jan.–June..	46.36	7.59	38.77	48.36	— 9.59	— .92
July–Dec...	65.69	8.81	56.88	48.78	+ 8.10	+ 7.18

* See accompanying text.

Though the statistics agree completely with this theory, they would of course agree also with a theory which assumed a decline to still lower levels in 1918, a rise to correspondingly higher levels following the armistice, and a subsequent decline in 1921 to or below the level here assumed. The theoretical ground for assuming such fluctuations in consumption, however, is not apparent. The only merit of such an assumption seems to be that it does not imply the accumulation of such heavy flour stocks in the winter of 1919–20. It is not unreasonable, however, to suppose that flour stocks did reach the levels indicated by the calculation in Table 5. There was a disposition to speculative accumulation of stocks of all kinds of commodities during this period unparalleled in recent history. Even the primary commercial stocks of flour (the series compiled by the Grain Corporation and continued by Russell), which have since reflected no influence from conditions leading to speculative accumulation of flour in other quarters, reached a level on January 1, 1920 nearly 10 million barrels above the figure for the previous July 1. After all, the figures for excess of stocks on January 1

and July 1, 1920 over the total on July 1, 1917, as shown in the last column of Table 5, indicate an excess over normal stocks for corresponding dates in other years amounting to no more than the current consumption during one and a half or two months. All the other figures in this column appear entirely reasonable. On the whole, we conclude that in the light of probable changes in flour stocks, the theory that per capita flour consumption in the United States has never risen above the war-time level accords better with the statistics of flour disappearance than any other theory, and that the estimates of consumption shown in the fourth column of Table 5 must be very close to the facts. The corresponding estimates of consumption by crop years are given in Appendix Table I and shown graphically in Chart 1 (p. 65). The population curve, shown for comparison in Chart 1, is adjusted for 1918 and 1919 to render it comparable with the consumption figures, by subtracting the figures for the number of men abroad with the American Expeditionary Forces.

VI. ANNUAL FLOUR PRODUCTION BY CROP YEARS SINCE 1879–80

Annual statistics of flour production are more useful if given by crop years than by calendar years, since the changes in production from year to year are closely related to the size and quality of the United States wheat crops and are therefore obscured in calendar year figures. There is also a technical advantage in making the estimates on a crop-year basis, owing to the fact that, for most of the period since 1879, production may be estimated most accurately by counting it equal to estimated consumption plus the net exports. Estimates of changes in flour stocks should also be included in such a calculation, but it is not feasible to attempt an estimate of the change in flour stocks between the beginning and the end of each year since 1879, and the neglect of these changes will introduce much less error with the figures on a crop-year basis. While the volume of flour stocks on hand in all positions on the first of January is subject to a good deal of variation from year to year, it appears that, with very few exceptions, stocks on July 1 are reduced to very much the same low levels each year. Probably the only important exceptions occurred in the period between 1917 and 1921, for which direct estimates of production are available. The estimates of flour production must in any case be subject to somewhat greater errors than the estimates of flour consumption, but with the figures on a crop-year basis the additional error in the production estimates probably exceeds 0.5 per cent in only a few years.

For the crop years 1917–18 to 1920–21 and 1923–24 to 1926–27, independent estimates of total flour production have already been obtained (pp. 68–71 and 89). These figures are repeated in column 3 of Appendix Table I. For other years the estimates of production are obtained by adding the net exports and shipments to the estimates of consumption.

The resulting estimates of annual flour production we believe to be seldom, if ever, more than 1.5 per cent wide of the facts. We have previously appraised the possible error in the estimates of consumption at probably 1 per cent or less, with the possible exception of the estimate for 1917–18 and the estimates for a few years in the neighborhood of 1904, in which the possibilities of error are slightly greater (pp. 81, 87 f.). The additional error in the estimates of production (when derived from the consumption estimates) we have just appraised at probably not over 0.5 per cent, giving a total possible error of 1.5 per cent without allowing for the probability of errors from the two sources offsetting each other. In thus appraising the possible errors in the statistics we have assumed the census statistics to represent substantially accurate and complete enumerations of the output of the classes of mills supposed to be covered and have further assumed the statistics of exports to be substantially complete.

The estimates of total flour output for each year are shown graphically in Chart 1 (p. 65) and Chart 11 (p. 99). The steady and rapid increase in annual flour output up to 1902–3 is striking. After 1902–3 flour exports declined and have since remained generally below the levels of the decade

preceding 1902–3. At about the same time, domestic flour consumption, per capita, began to decline. The two circumstances, coming together, produced a sharp change in the trend of flour production about 1902. The sharp decline in domestic flour consumption in 1917–18 was more than offset by the increase in flour exports—in this and the following year. In 1919–20 flour exports declined somewhat, but the purchases of flour going into the excessive stocks which were accumulated in that year made 1919–20 the record year by a wide margin for American flour milling. The prosperity was short-lived, for the next year saw the lowest flour output since 1896–97. Since 1920–21 the American milling industry has continued to feel keenly the effects of the decline in domestic consumption of flour. With the growth in population of the United States, however, total domestic consumption has more than regained its pre-war level and, assuming no material reduction in flour exports, a steady increase in the annual output of American flour mills may confidently be anticipated.

VII. WHEAT GROUND PER BARREL OF FLOUR

Having obtained reliable estimates of annual production of flour since 1879–80, it is desirable to complete the statistics of milling over this period by adding estimates of wheat ground and of millfeed produced. For this purpose statistics or estimates of milling ratios are essential. We find that the milling ratio is not by any means a constant, the range of variation, excluding the war years when milling ratios were sharply reduced, being over 3 per cent. Data are available, however, for estimating the wheat requirement per barrel of flour for each crop year since 1885–86 with a possibility of error only rarely exceeding 0.5 per cent. We undertake, therefore, in this section a study of milling ratios, upon which is based a series of estimates of the wheat ground per barrel of flour in each crop year since 1885–86.

Customary Procedure and Its Defects

For many years it has been customary to convert flour statistics into terms of wheat or wheat into terms of flour at a rate of 4.5 bushels of wheat per barrel of flour. Such a conversion ratio is commonly obtained by large commercial mills grinding wheat of good test weight, and the figure is a convenient one for calculation; but the average wheat requirement per barrel of flour for all mills of the United States, large and small, grinding some wheat of high test weight, some of low test weight, is considerably above 4.5 bushels per barrel of flour. The United States averages for census years are readily calculated by dividing the total flour production into the total quantity of wheat ground, as reported by the census. The milling ratios thus obtained for each census since 1889 are shown in the first column of Table 6. Considering for the present only the combined figure for "all merchant mills," it appears that in most years the wheat requirement runs close to 4.7 bushels per barrel of flour.[1] Neglecting the year 1919, in which the milling ratio reflects the influence of the high extraction maintained during the war and immediate

Table 6.—Bushels of Wheat Required per Barrel of Flour, Based on Census Data for 1889–1925*

Calendar year	All merchant mills	Merchant mills producing			Custom mills
		100,000 bbls. or over	1,000 to 100,000 bbls.	Under 1,000 bbls.	
1889.....	4.765	.....	.....	.....	.....
1899.....	4.724	.....	.....	.....	9.765
1904.....	4.750	.....	.....	.....	.....
1909.....	4.695	.....	.....	7.942	5.170
1914.....	4.688	4.585	4.864	4.334	.....
1919.....	4.624	4.577	4.693	6.318	5.066
1921.....	4.702	4.604	4.882	7.715	.....
1923.....	4.704	4.621	4.791	16.503	.....
1925.....	4.653	4.604	4.714	12.632	.....

* Calculated by dividing "wheat milled" by "flour produced," as derived from the reports of the censuses of manufactures. Census publications show wheat milled and flour produced by all merchant mills, by custom mills, and by merchant mills producing 100,000 barrels or over and 1,000 barrels or over. These figures permit calculation of the corresponding data for the classifications of "merchant mills producing 1,000 to 100,000 barrels" and "under 1,000 barrels." See discussion on p. 96 below. Dots (....) indicate that data are not available.

[1] Cf. Wheat Studies, June 1926, II, 246, 261–62, in which the net exports of wheat and of flour in terms of wheat are recalculated, using the ratio of 4.7 bushels of wheat per barrel for the conversion of flour into terms of wheat.

post-war period, the extreme range is from 4.65 to 4.76 bushels per barrel.

Further study has indicated that the variations in the milling ratio for all merchant mills as shown in Table 6 are themselves significant and that changes in the average quality of the wheat crop of the United States from year to year explain most of the variations in the average milling ratio for the country. These variations are worth considering, for in a year in which the milling ratio is 4.65 bushels per barrel of flour the wheat requirement for an output of 115,000,000 barrels of flour is 5,750,000 bushels less than would be calculated if the ratio of 4.70 bushels were used. Similarly, in a year in which the actual milling ratio is 4.75 bushels per barrel, the wheat actually ground for such a flour output is 5,750,000 bushels more than would be calculated using the 4.70 ratio.

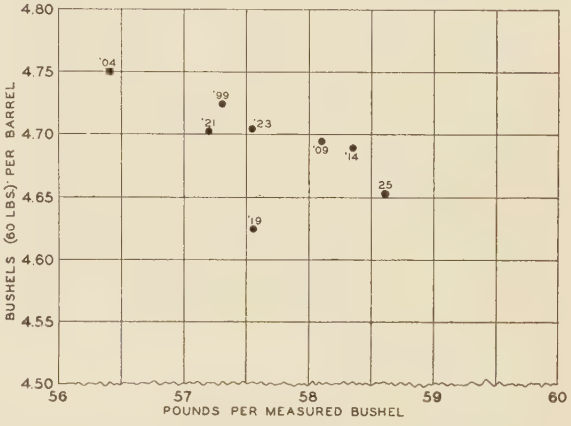
The Factor of Test Weight

The quantity of wheat required per barrel of flour is different for different types of wheat and different for the several varieties in any one type. For a given variety of wheat, the quantity required per barrel of flour varies materially with the test weight. More wheat, in pounds, is required to mill a barrel of flour from wheat of low test weight than from wheat of high test weight. The wheat requirement per barrel varies also with the type of flour milled and with the type of mill and method of operation. Taking the mills of the country as they are, however, with the qualities of flour actually produced and the types and varieties of wheat actually milled, the principal cause of variations from year to year in the milling ratio for the country as a whole is to be looked for in the variations in average test weight of the wheat milled.

Estimates of the average test weight of the wheat crop of the United States as prepared by the United States Department of Agriculture for each crop since 1885 are shown in Table 8 (p. 94). Through comparisons of the milling ratio shown by the census statistics with the estimated test weight of the crops milled in the census years, it appears that there is in fact a very close relation between the estimated test weight of the crops and the wheat requirements per barrel of flour as shown by the census data. This appears clearly in Chart 8. The census milling statistics apply to calendar years and therefore cover wheat from two successive crops. The recent monthly statistics of milling indicate that the wheat milled in one calendar year is derived in almost exactly equal amounts from the harvest of the preceding calendar year and the

Chart 8.—Relation of Wheat Required per Barrel of Flour to Weight per Bushel of the Wheat*

(United States averages)



* Data from Tables 6 and 8. The wheat ground per barrel of flour, as shown by the censuses of manufactures for all merchant mills, exhibits a close relationship with the average weight per bushel of the crops as shown by the Department of Agriculture estimates. The lower the test weight per measured bushel, the higher the number of 60-lb. bushels required per barrel of flour. The low wheat requirement in 1919 reflects the influence of the high extraction obtained during the war period.

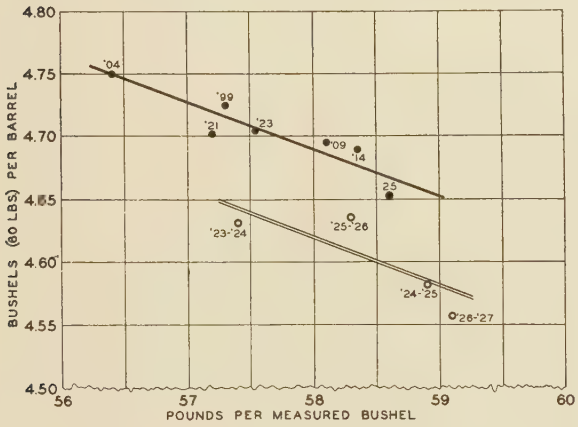
harvest of the calendar year to which the milling statistics apply. The test weight of the wheat milled in any calendar year may therefore be taken as the average of the test weights for the crops of that year and of the previous year. These are the weights per bushel used for Chart 8.

The wheat requirement per barrel shown for 1919 is clearly much below that to be expected from the estimated weight per bushel of the wheat milled in that year, judged in the light of the relationship between test weight and wheat requirement per barrel of flour for other years. The high flour extraction in 1919 thus indicated is undoubtedly an effect of the war-time restrictions on flour milling, and may be neglected in determining the normal relationship between estimated test weight and

wheat requirements per barrel of flour. The formal restrictions were removed by the opening of the year, but much short patent flour continued to be milled for export and shipment to relief organizations at least.

In addition to the data on wheat requirements per barrel of flour obtainable from the census figures, we have for the period since 1923–24 similar data available from the monthly milling reports. These figures may be computed for crop years, as shown in Table 7, and set against the estimated weight per bushel of the crop in question. The results are shown in Chart 9, together with a repetition of the data in Chart 8, omitting 1919.

CHART 9.—RELATIONS OF WHEAT REQUIRED PER BARREL OF FLOUR BY TWO DIFFERENT CLASSES OF MILLS TO WEIGHT PER BUSHEL OF THE WHEAT*



* Data from Tables 6, 7, and 8. With the same weights per bushel of the crops, the wheat ground per barrel of flour by the mills included in the monthly milling reports of the Department of Commerce (the hollow circles) averages about 1.5 per cent less than that for all merchant mills as shown by the censuses of manufactures (the solid dots). For each group, an increase of one pound in test weight of the wheat lowers the wheat requirement 0.038 bushels per barrel.

The wheat requirements per barrel of flour shown by the monthly milling reports, as they appear in Chart 9, show the same general correspondence with the estimated weight per bushel of the crop as the wheat requirements per barrel calculated from the census data, but on a lower level. This is to be expected from the fact that the mills covered in the monthly milling reports are larger than the average for the country and in general obtain a higher extraction than is shown in an average for all merchant mills.

To determine the normal relationship between average weight per bushel of the wheat crop of the United States and the quantity of wheat required per barrel of flour, the two straight lines appearing in Chart 9 have been fitted to the two groups of data shown on the chart. It has been assumed that the effects of changes in test weight are the same for the mills included in the monthly milling reports as for the larger group included in the censuses, the only difference being that the wheat requirement per barrel is higher at all test weights for the larger group, which includes more small mills. The lines have therefore been fitted using an adaptation of the method of least squares which gives the best

TABLE 7.—BUSHELS OF WHEAT REQUIRED PER BARREL OF FLOUR, ACCORDING TO UNITED STATES GRAIN CORPORATION DATA, 1917–18 TO 1919–20, AND MONTHLY MILLING REPORTS, DEPARTMENT OF COMMERCE, 1923–24 TO 1926–27

Year July–June	Bushels	Year July–June	Bushels
1917–18	4.533[a]	1923–24	4.631[b]
1918–19	4.450[a]	1924–25	4.582[b]
1919–20	4.645[a]	1925–26	4.635[b]
		1926–27	4.570[b]

[a] Calculated from "wheat milled" and "flour produced" as reported to the U.S. Food Administration Grain Corporation and the U.S. Grain Corporation in *Supplement to Grain and Flour Statistics during the War* (1920), p. 22.

[b] Calculated from "wheat milled" and "flour produced" by all reporting mills as shown by the monthly milling reports of the U.S. Department of Commerce.

TABLE 8.—ESTIMATED WEIGHT PER MEASURED BUSHEL OF UNITED STATES WHEAT CROPS, 1885–1926*

Crop of	Pounds per bushel	Crop of	Pounds per bushel	Crop of	Pounds per bushel
1885	58.3	1899	56.9	1913	58.7
1886	57.0	1900	56.3	1914	58.0
1887	58.4	1901	57.5	1915	57.9
1888	58.5	1902	57.6	1916	57.1
1889	56.5	1903	57.3	1917	58.5
1890	57.7	1904	55.5	1918	58.8
1891	57.2	1905	57.5	1919	56.3
1892	58.5	1906	58.3	1920	57.4
1893	57.5	1907	58.2	1921	57.0
1894	57.6	1908	58.3	1922	57.7
1895	58.3	1909	57.9	1923	57.4
1896	57.6	1910	58.5	1924	58.9
1897	57.1	1911	57.8	1925	58.3
1898	57.7	1912	58.3	1926	59.1

* Data from U.S. Department of Agriculture, *Wheat and Rye Statistics* (January 1926), and *Crops and Markets, Monthly Supplements.*

possible fit for two straight lines under the condition that the lines shall be parallel.[1]

This calculation indicates, in the first place, that a test weight of 58 pounds per measured bushel for the wheat crop of the country results, on the average, in a wheat requirement for all the merchant mills of the country of 4.69 bushels (of 60 lbs.) per barrel of flour. The mills included in the monthly milling report, averaging larger, show a wheat requirement of 4.62 bushels per barrel for the same test weight per bushel of the crop. From the above it follows that the wheat requirements per barrel of flour shown by the monthly milling reports should be raised 1.5 per cent to render them comparable with the figures for all merchant mills. In the second place, it appears that with each pound of increase or decrease in the test weight per bushel the wheat requirement decreases or increases by 0.038 bushel per barrel.

Other Factors Affecting Milling Ratio

While the wheat requirement per barrel of flour is closely related to the test weight of the crop, several other conditions occasionally have some influence upon it. A certain fraction of the crop is always exported, the exports consisting chiefly of the less desirable milling wheats. In a year of large crop the mills may grind relatively little of the lighter wheats, for which the wheat requirement per barrel is high. This results, as in the year 1926–27, in an average wheat requirement lower than would be expected from the weight of the crop as a whole. Milling of large quantities of Canadian wheat, which permits a high extraction, will similarly lower the average wheat requirement.

In some years certain peculiarities of the crop not reflected in the test weight modify the wheat requirement per bushel. The winter-wheat crop of 1925, though showing a good test weight, was disappointing in its flour yields, owing to unusual thickness of the coat of the berry, resulting in high bran yields and a considerably larger wheat requirement per barrel of flour than should have been expected from the test weight of the wheat. The average wheat requirement shown by the monthly milling reports for 1925–26 was 4.635 bushels per barrel of flour, nearly 0.03 bushels or 1.8 pounds per barrel greater than would have been expected from the estimated weight per bushel of the crop. (See Chart 9.)

Changes in the average quality of the flour milled will markedly affect the wheat requirement per barrel of flour. The wartime regulations, limiting the production of short patent flour, apparently lowered the wheat requirement per barrel of flour by about 4 per cent (see p. 98, below). In ordinary times, however, the proportions of short and long patent flour milled in the United States are practically constant from year to year.

The introduction of the roller process of milling in the United States greatly reduced the wheat requirement per barrel, but this change seems to have been practically completed by the time the census of 1900 was taken. The wheat requirement per barrel of flour in 1899 was almost exactly at the figure to be expected in the light of subsequent milling experience. The wheat requirement shown by the census of 1889, however, was nearly 1 per cent higher than would have been expected for an equal weight per bushel of the crop under present milling conditions.

It would seem reasonable to suppose that the gradual elimination of the smaller mills should have resulted in a progressive reduction in the country-wide average wheat requirement per barrel of flour, even after the use of the roller process became prac-

[1] The equations for the two lines are:

for wheat requirement, based on census data,

$$r = 6.896 - 0.03805w;$$

for wheat requirement, based on monthly milling reports data,

$$r = 6.826 - 0.03805w;$$

where

r = bushels of wheat (60 lbs.) required per barrel of flour, and

w = estimated weight of the wheat in pounds per bushel.

The constants for the equation above were obtained in a single solution, using the equation of relationship,

$$r = a + bw + ck;$$

where r and w are defined as above and

$k = 0$, for observations in which r is derived from the census data, and

$k = 1$, for observations in which r is derived from the monthly milling reports.

Solution by the method of least squares yielded the equation,

$$r = 6.896 - 0.03805w - 0.070k,$$

which is more readily used in the form of the two separate equations given above.

tically universal. The statistics, however, yield no evidence of this. Apparently the effect of the elimination of the smaller mills has been too small to be observable in the statistics, or else some other influence has produced an approximately equal opposite effect on the average wheat requirement per barrel of flour. Some such influence may have been exerted by the establishment of the maximum moisture content of flour at 13.5 per cent, made generally effective about 1908 under the Food and Drugs Act.

Despite the presence of these and other influences modifying the annual average wheat requirement per barrel of flour, it appears that the principal factor involved is the weight per measured bushel of the wheat. The evidence for this conclusion appears clearly in the close grouping of the actual observations about the two lines of relationship shown in Chart 9 (p. 94).

Supporting Evidence on Influence of Size of Mills

The conclusions stated above may be checked by comparison with other information bearing on the same questions. The difference between the average wheat requirement per barrel of flour for all the merchant mills of the country included in the censuses of manufactures and that for the larger mills of the country, such as predominate in the data from the monthly milling reports, may be checked from the census statistics for mills in different size groups. The census gives statistics of flour produced and wheat ground for all merchant mills included at each census, and for merchant and custom mills, combined, at each decennial census. Beginning with 1909 a separate tabulation is shown for merchant mills producing 1,000 barrels of flour and over. Beginning with 1914 a separate tabulation is shown also for mills producing 100,000 barrels of flour and over. From these statistics it is possible to compute for several censuses the wheat requirement per barrel of flour for all merchant mills, for all custom mills, and for merchant mills falling into three different size groups. The average wheat requirements thus obtained are shown in Table 6 (p. 92), the figures for all merchant mills being those used in the foregoing discussion.

The wheat requirement shown for all merchant mills is in two years 0.10 bushel per barrel over the figure for mills producing 100,000 barrels or over, in a third year, 0.08, and in 1919, only 0.05 over the latter figure. Omitting 1919, which probably represents abnormal conditions, the evidence is that the wheat requirement for all merchant mills runs quite uniformly about 2 per cent above the wheat requirement for mills producing 100,000 barrels or over.

The mills producing between 1,000 and 100,000 barrels of flour show in two years a wheat requirement 6 per cent over that for the mills producing 100,000 barrels or over. In a third year this wheat requirement is less than 4 per cent higher than that for the large mills, and in 1919, less than 3 per cent higher.

The figures for mills producing under 1,000 barrels of flour and for custom mills show an extraordinary variation. The figures for custom mills in 1909 and in 1919 appear reasonable and may be trustworthy. The figures for merchant mills producing under 1,000 barrels are in all cases quite unreasonable and are clearly of no value. The errors may be due to inaccuracies in the original schedules or they may be the result of errors in the tabulation of the data. It must be remembered that the figures for wheat ground and flour produced by mills producing under 1,000 barrels have to be arrived at by subtracting the corresponding figures for mills producing over 1,000 barrels from the figures for all merchant mills. In 1923 all merchant mills were reported to have ground 538,312,078 bushels of wheat, of which 531,935,511 bushels were ground by mills producing over 1,000 barrels of flour. This left 6,376,567 bushels to be accounted for by the mills producing under 1,000 barrels of flour. A relatively insignificant error in the tabulation of wheat ground by the mills producing over 1,000 barrels of flour, for example, would result in an equal error in the figure for mills producing under 1,000 barrels (obtained by subtraction from the total), and in the latter figure such an error might be very serious.

The difference of 2 per cent between the wheat requirement per barrel for all merchant mills and the wheat requirement for mills producing over 100,000 barrels of flour accords perfectly with our finding of a dif-

ference of 1.5 per cent between the wheat requirement for all merchant mills and that for the mills included in the monthly milling reports. The monthly milling reports include many mills producing less than 100,000 barrels of flour and therefore differ less from the average for all merchant mills than do the mills producing 100,000 barrels and over. In 1923 the 247 mills producing over 100,000 barrels of flour had an average output per mill of 344,031 barrels. In 1923–24, the most nearly comparable period available, the 955 identical mills included in the monthly milling report had an average output of 106,338 barrels per mill.

Experimental Evidence on Influence of Test Weight

As a check on the statistical evidence of the effect of variation in test weight on wheat requirement per barrel of flour, there are available numerous tests under experimental conditions. The United States Department of Agriculture has published the results of extensive milling experiments on the wheat requirements per barrel of flour for the principal classes of wheat of various test weights per bushel.[1] Averaging these figures for the five principal classes of wheat, with due allowance for the differences in the quantities of each class milled in the United States, gives the wheat requirements shown in the last column of Table 9.

The weighted average of the experimental results shows an average change in wheat required per barrel of flour amounting to about 0.042 bushel for each pound change in test weight, agreeing quite closely with the figure of 0.038 derived from the statistics. The experimental results are also in remarkably close agreement with the statistics as regards the wheat requirements indicated for each test weight. For a test weight of 58, they show a wheat requirement of 4.70 bushels per barrel, agreeing almost exactly with the requirement of 4.69 bushels indicated by the statistics. The close agreement in this respect is largely fortuitous and is chiefly significant in indicating that the efficiency of the test mill, as operated, was less than that of large commercial mills, but greater than that of the smaller commercial mills, yielding results closely representative of average milling conditions in the United States.

[1] Cf. *Wheat and Rye Statistics*, p. 86.

Table 9.—Wheat Requirements per Barrel of Flour for Different Test Weights, by Classes, and Weighted Average*

Test weight, pounds per measured bushel	Wheat required per barrel of flour (60-lb. bushels)					
	Hard red spring	Durum	Hard red winter	Soft red winter	White	Weighted average[a]
56	4.80	5.02	4.63	4.85	4.88	4.78
57	4.73	4.89	4.62	4.81	4.78[b]	4.73
58	4.69	4.75	4.61	4.78	4.72	4.70
59	4.61	4.72	4.58	4.69	4.69	4.64
60	4.60	4.65	4.55	4.69	4.65	4.62
61	4.55	4.60	4.51	4.62	4.64	4.57

* Data from *Wheat and Rye Statistics*, p. 86, based on experimental milling tests by the milling laboratory, Bureau of Agricultural Economics, in terms of dockage-free wheat.

[a] The weights used in calculating the averages are, in the order in which the classes of wheat are listed: 2, 0.4, 3, 3, 1.

[b] Owing to a typographical error, this figure appears as 4.88 in the Department of Agriculture bulletin.

Annual Estimates of Wheat Milled per Barrel of Flour

The foregoing study of wheat requirements per barrel of flour provides a basis for estimating the average quantity of wheat milled per barrel in each crop year since 1885–86. For the years 1885–86 to 1916–17 and 1920–21 to 1922–23, the estimates must be obtained by calculation from the estimated test weight per bushel on the basis of the relationship discussed above.

For the years 1917–18 to 1919–20 and 1923–24 to 1926–27, there are available the statistics compiled by the Grain Corporation and by the Department of Commerce from which the milling ratios for those years may be obtained with less chance of error than if the estimates were based on the reported average test weight of the crop. The milling ratios derived from the Grain Corporation figures for 1918–19 and 1919–20, representing practically complete reports for all merchant mills, may be taken as they stand. It has been shown above (pp. 94–95) that the wheat requirements per barrel of flour shown by the monthly milling reports of the Department of Commerce must be raised 1.5 per cent to obtain the approximate average for all merchant mills. It appears also that the milling ratio shown by

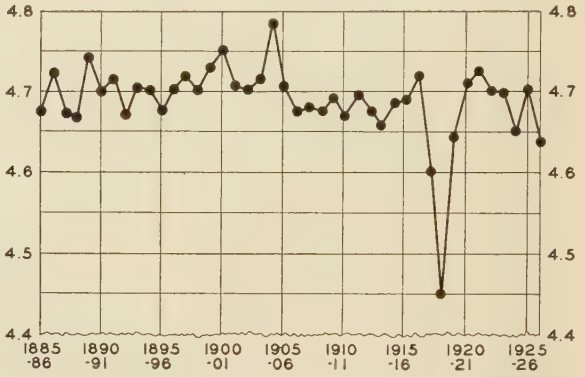
the Grain Corporation figures for 1917–18 must be raised by a like amount. The reports obtained for 1917–18 cover about the same percentage of the total output as is included in the monthly milling reports, and seem, like the latter reports, to represent chiefly the larger mills of the country.

The estimates of wheat milled per barrel of flour, as thus obtained for each crop year since 1885–86, are given in Appendix Table I, column 2, and shown graphically in Chart 10. Neglecting the years affected by war-time regulation, the average is very close to 4.7 bushels per barrel, the figures ranging from 4.639, in 1926–27, when the average weight of the crop was reported as 59.1 pounds per bushel,[1] to 4.784, in 1904–5, when the average weight of the crop was reported as only 55.5 pounds per bushel. Under the influence of the high rate of extraction enforced during the war, the milling ratio fell to 4.450 in 1918–19. This very low wheat utilization was made possible in part, however, by the good weight of the crop of that year, reported at 58.5 pounds per bushel. With wheat of this weight the average milling ratio would ordinarily be only 4.659 bushels per barrel. The Food Administration restrictions apparently resulted in saving about 13 pounds of wheat per barrel of flour in this year.

The maximum error to be expected in the estimates of the quantity of wheat milled per barrel of flour seems for most of the period to be in the neighborhood of 0.5 per cent, judged by the deviations of individual observations from the lines of average relationship shown in Chart 9 (p. 94). Exception must be made, however, of the estimates for the first ten years or so, which are probably mostly too low. It seems clear that the average wheat requirement per barrel of flour, for any given weight per bushel, was slightly higher in these early years, when the transition to the roller process of milling was still in progress, than it has been subsequently. We have found no trustworthy basis, however, for determining the adjustment required, and have neglected this factor in making our calculations.

CHART 10.—WHEAT GROUND PER BARREL OF FLOUR, 1885–86 TO 1926–27*

(Bushels)



* Data in Appendix Table I. About 4.7 bushels of wheat are required per barrel of flour, as an average over a period of years for all merchant mills in the United States; but following our entry into the war the wheat requirement was reduced to 4.45 bushels per barrel. The range of variation, omitting the crop years 1917–18 and 1918–19, is from 4.64 to 4.78 bushels per barrel, depending chiefly on the average weight per bushel of the wheat crop of the country. This variation, under normal conditions, amounts to only about 3 per cent, but on a total output of 115 million barrels of flour it may affect the amount of wheat ground by over 16 million bushels.

VIII. WHEAT GROUND AND MILLFEED PRODUCED ANNUALLY SINCE 1885–86

Having obtained estimates of the total flour output of the mills of the United States in each crop year since 1879–80 and of the wheat ground per barrel of flour in each year since 1885–86, it is a simple matter to calculate the approximate total quantity of wheat ground and of millfeed produced in each crop year since 1885–86. The quantity of wheat ground is given directly by multiplying the estimate of total flour production by the estimate of wheat ground per barrel of flour. The resulting figures are shown in column 1 of Appendix Table I.

Such errors as exist in the estimates of total quantity of wheat milled each year are the result of a combination of errors in the production estimates and errors in the estimates of wheat ground per barrel of flour. If the possible magnitude of these errors has been correctly appraised, the errors in

[1] Calculation on the basis of the usual relationship between test weight and wheat requirement would have given a figure of 4.647 bushels per barrel for this year. The figure of 4.639, 0.2 per cent lower, is based on the data in the monthly milling reports.

the estimates of total wheat milled can seldom, if ever, exceed 2 per cent.[1]

The average millfeed output per barrel of flour is readily calculated from the figures for wheat ground per barrel. The latter figures are in terms of 60-pound bushels, hence with a wheat requirement of 4.7 bushels per barrel, 282 pounds of wheat are ground to obtain 196 pounds of flour, leaving 86 pounds of millfeed. Similar calculations yield the theoretical output of millfeed per barrel of flour for any stated wheat requirement per barrel.

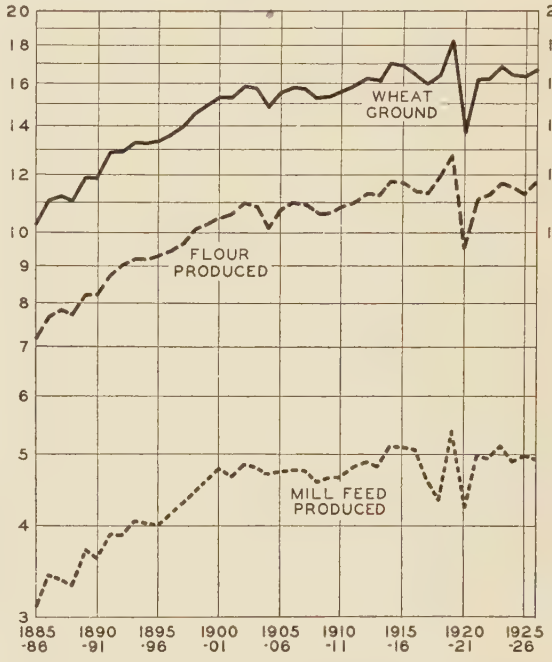
There is almost always an "invisible loss" in milling, the combined weight of the products being less than that of the wheat passing into the rolls, a consequence, chiefly, of loss of moisture in the milling process. In terms of weight of wheat purchased and weight of products available for sale, however, there is not uncommonly an "invisible gain." Dry wheat requires the addition of a considerable amount of moisture to temper it for grinding, and the moisture content of the flour and millfeed may be appreciably in excess of the moisture contained in the equivalent quantity of wheat as it came from the cars. This is uniformly the case with Pacific Coast wheats and frequently the case with wheat from other sections. As far as we can determine from available statistics, a slight gain in weight of the products, for the country as a whole, is the general rule, but the amount involved is too small and uncertain to deserve further consideration in these estimates.

Taking the output of millfeed at the theoretical value for each year, based on the quantity of wheat milled per barrel of flour, we obtain the annual estimates of millfeed produced, as shown in column 4 of Appendix Table I. These figures are subject to somewhat larger percentage errors than any of the other estimates included in the appendix tables. If the errors in the estimates of wheat milled per barrel of flour occasionally amount to 0.5 per cent or more, there are occasional errors of 1.6 per cent in the estimates of millfeed produced per barrel.[2] Combining these possible errors with those which may exist in the estimates of flour production leads to the conclusion that the errors in the estimates of millfeed produced may occasionally reach 3 per cent.[3]

The estimates of wheat ground and flour and millfeed produced annually since 1885–86 are shown graphically in Chart 11. To facilitate direct comparison in a single chart, all the figures have been expressed in tons of 2,000 pounds. A logarithmic vertical scale has been used for this chart in order to render the percentage changes in the several series more readily comparable. The three series necessarily show the same trend and roughly similar fluctuations from year

CHART 11.—WHEAT GROUND AND FLOUR AND MILLFEED PRODUCED, 1885–86 TO 1926–27*

(Million tons)



* Data in Appendix Table I. Plotted to a logarithmic vertical scale, showing the relative changes in their correct proportion, the quantities of wheat ground and of flour and millfeed produced annually show the same general trend, and the change in trend about 1904 appears even more pronounced than when the data are plotted on an arithmetic scale. (Compare with the curve of flour production in Chart 1, p. 65.) The changes in the three series from year to year differ somewhat, owing to changes in the quantity of wheat ground and of millfeed produced per barrel of flour.

[1] Again making no allowance for offsetting errors, the approximate maximum percentage error is

$$100(1.015\times1.005)-100=2.$$

[2] An error of 0.5 per cent in the wheat requirement is equivalent to 1.4 pounds per barrel of flour, and would involve an equal error in the estimate of millfeed produced per barrel, which is 1.6 per cent of the average amount of millfeed produced with each barrel of flour.

[3] $100(1.015\times1.016)-100=3.$

to year. Changes in the wheat requirement per barrel of flour, however, introduce divergencies in the year-to-year movements of the three curves. This effect is most conspicuous during the war-time period of high flour extraction.

This study has been prepared by Holbrook Working. The directors of the Institute and other members of the staff have contributed information on a number of points. Most of the tabulations and computations have been made by Adelaide M. Hobe, and the charts have been prepared by Douglas L. King

APPENDIX

REFERENCES AND EXPLANATION FOR APPENDIX TABLES

TABLE I

The flour trade statistics are from publications of the Bureau of Foreign and Domestic Commerce, with additions in 1917–18 and 1918–19 noted below the table. The remaining figures are new estimates prepared by the Food Research Institute by the methods explained in the text. For the years 1879–80 to 1916–17 the estimates of per capita flour consumption are derived first (see pp. 85–87), and from these the total consumption is calculated. For the years 1917–18 to 1926–27 the total flour consumption is estimated from calculated trends, slightly adjusted in 1917–18 and 1918–19 to reflect the influence of special circumstances (see pp. 75 and 89–90), and the per capita consumption calculated from the estimated totals. Total flour output is estimated independently for the years 1917–18 to 1920–21 and 1923–24 to 1926–27 (see pp. 70–71 and 89). For other years it is obtained by adding the net exports and shipments to the total estimated consumption. The quantity of wheat ground per barrel of flour is estimated independently for each year beginning with 1885–86 (see pp. 97–98). The estimates of total quantities of wheat ground and of millfeed produced are obtained by calculation from the estimates of total flour output and of wheat ground per barrel of flour.

TABLE II

The flour trade statistics are from the *Monthly Summary of Foreign Commerce of the United States,* except shipments to possessions, which are no longer published monthly and have been supplied by the Department of Commerce. The "commercial stocks" are Russell's estimates, from *Russell's Commercial Review.* The remaining figures are new estimates prepared by the Food Research Institute. The estimates of monthly output are derived from the monthly milling reports of the Department of Commerce, as described on pp. 70–71, above. The monthly domestic disappearance is the estimated output, less net exports and shipments to possessions. The monthly consumption is estimated by computing the trend of consumption per day and multiplying the monthly ordinates of trend by the number of days in the month (see pp. 74–75). Changes in stocks between the beginning and the end of each month are estimated by subtracting the estimated consumption from the domestic disappearance, and from these figures are derived the estimates of total stocks on the first of each month, in terms of deviations from the 4-year average (see pp. 75–76). The estimates of "non-commercial" stocks are derived from the estimates of total stocks by subtracting Russell's estimates of commercial stocks, expressed as deviations from the 4-year average.

TABLE I.—WHEAT MILLING AND FLOUR DISPOSITION BY CROP YEARS FROM 1879–80 TO 1926–27*

Year July–June	Wheat ground		Flour output	Millfeed output	Flour consumption		Flour trade *(thousand barrels)*				
	Total *(thous. bushels)*	Per bbl. *(bushels)*	*(thous. bbls.)*	*(thous. tons)*	Total *(thous. bbls.)*	Per capita *(bbls.)*	Net exports and shipments	Imports	Re-exports	Domestic exports	Shipments to possessions
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1879–80	.....	.....	62,800	.....	56,800	1.147	6,009	5.2	2.9	6,011	...[a]
1880–81	.....	.....	66,100	.....	58,200	1.147	7,945	2.4	1.5	7,946	...
1881–82	.....	.....	65,400	.....	59,500	1.147	5,915	4.2	3.3	5,916	...
1882–83	.....	.....	70,100	.....	60,900	1.147	9,205	2.5	1.7	9,206	...
1883–84	.....	.....	71,400	.....	62,300	1.147	9,150	1.8	0.2	9,152	...
1884–85	.....	.....	74,300	.....	63,700	1.147	10,647	1.3	...	10,648	...
1885–86	342,900	4.678	73,300	3,100	65,100	1.147	8,177	1.8	0.4	8,179	...
1886–87	369,100	4.727	78,100	3,420	66,600	1.147	11,517	1.0	...	11,518	...
1887–88	374,000	4.674	80,000	3,380	68,000	1.147	11,964	2.6	2.6	11,964	...
1888–89	368,600	4.670	78,900	3,320	69,500	1.147	9,374	1.2	...	9,375	...
1889–90	396,200	4.746	83,500	3,700	71,200	1.147	12,233	1.2	2.3	12,232	...
1890–91	395,200	4.701	84,100	3,620	72,700	1.147	11,344	8.4	8.4	11,344	...
1891–92	420,700	4.720	89,100	3,890	73,900	1.147	15,196	0.6	0.1	15,197	...
1892–93	429,600	4.670	92,000	3,870	75,400	1.147	16,620	0.4	...	16,620	...
1893–94	441,100	4.708	93,700	4,050	76,800	1.147	16,860	0.4	...	16,860	...
1894–95	440,200	4.704	93,600	4,040	78,300	1.147	15,267	1.9	...	15,269	...
1895–96	441,800	4.678	94,400	4,000	79,800	1.147	14,620	1.4	0.2	14,621	...
1896–97	451,200	4.704	95,900	4,140	81,300	1.147	14,569	2.2	1.3	14,570	...
1897–98	464,000	4.723	98,200	4,290	82,900	1.147	15,348	2.7	1.4	15,350	...
1898–99	483,900	4.701	102,900	4,430	84,500	1.147	18,486	0.9	1.0	18,486	...
1899–1900	496,300	4.731	104,900	4,610	86,200	1.147	18,698	0.7	0.1	18,699	...
1900–01	508,600	4.754	107,000	4,770	88,100	1.147	18,886	0.6	16.4	18,651	220
1901–02	508,200	4.708	108,000	4,670	90,000	1.147	18,002	0.4	0.2	17,759	243
1902–03	525,800	4.704	111,800	4,820	91,600	1.145	20,126	0.6	0.7	19,716	410
1903–04	519,100	4.716	110,000	4,790	92,700	1.135	17,374	46.9	36.1	16,999	386
1904–05	492,200	4.784	102,900	4,680	93,700	1.126	9,141	40.8	3.8	8,826	352
1905–06	513,300	4.708	109,000	4,710	94,700	1.116	14,292	45.3	...	13,919	418
1906–07	522,500	4.678	111,700	4,730	95,700	1.106	15,985	47.7	0.5	15,585	447
1907–08	519,400	4.681	111,000	4,710	96,600	1.096	14,319	39.6	0.1	13,927	432
1908–09	505,300	4.678	108,000	4,570	97,100	1.087	10,902	92.4	...	10,521	473
1909–10	506,700	4.693	108,000	4,620	98,600	1.077	9,391	144.8	...	9,041	495
1910–11	513,400	4.670	109,900	4,630	99,400	1.067	10,500	141.6	...	10,129	513
1911–12	522,700	4.697	111,300	4,770	99,900	1.058	11,366	158.8	0.1	11,006	519
1912–13	536,100	4.678	114,600	4,850	100,800	1.048	13,832	107.6	1.0	13,395	544
1913–14	532,600	4.662	114,200	4,780	102,000	1.038	12,267	89.9	1.4	11,822	534
1914–15	558,900	4.689	119,200	5,090	102,600	1.029	16,625	64.2	1.5	16,183	504
1915–16	557,100	4.693	118,700	5,080	103,000	1.019	15,751	329.9	10.2	15,521	550
1916–17	547,100	4.723	115,800	5,060	103,500	1.009	12,296	174.7	2.2	11,943	526
1917–18	530,900	4.601	115,400	4,620	94,000	.907[b]	22,932	675.1	79.5	23,096[c]	432
1918–19	545,000	4.450	122,500	4,350	91,500	.888[b]	29,579[c]	37.1	0.8	29,083[c]	532
1919–20	605,900	4.645	130,400	5,390	94,600	.895	22,141	159.1	12.8	21,652	635
1920–21	458,200	4.712	97,200	4,220	96,300	.897	15,364	1,420.9	45.9	16,180	559
1921–22	537,900	4.727	113,800	4,990	98,000	.898	15,820	619.1	84.2	15,797	558
1922–23	539,200	4.701	114,700	4,940	99,600	.900	15,068	429.4	13.3	14,883	601
1923–24	560,500	4.700	119,300	5,130	101,500	.901	17,708	169.1	13.3	17,253	611
1924–25	546,600	4.651	117,500	4,880	103,000	.902	14,508	6.7	5.4	13,920	590
1925–26	542,900	4.705	115,400	4,980	104,600	.902	10,103	17.4	11.0	9,542	567
1926–27	554,100	4.639	119,400	4,920	106,100	.902	14,025	6.1	3.6	13,385	642

* For explanatory notes see p. 100.

[a] Included in domestic exports to 1899–1900.

[b] Expeditionary forces excluded from population estimate.

[c] Including, in addition to the Department of Commerce figures, shipments to the A.E.F., A.R.C., and relief organizations as reported by the Food Administration and the Grain Corporation, totaling 1,216,000 barrels in 1917–18 and 4,890,000 barrels in 1918–19.

TABLE II.—FLOUR OUTPUT AND DISPOSITION, MONTHLY FROM MAY 1923*

(Thousand barrels)

Year and month	Output	Domestic disappearance	Consumption	Stocks (first of month)			Trade				
				Commercial	Non-commercial[a]	Total[a]	Net exports and shipments	Imports	Re-exports	Domestic exports	Shipments to possessions
1923	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
May	9,153	8,127	8,539	7,457	—1,292	—1,097	1,026	19.4	5.4	983	57
June	7,776	6,928	8,274	6,800	—1,047	—1,509	848	17.7	.2	806	60
July	9,048	8,130	8,560	6,900	—2,493	—2,855	918	18.2	.0	884	52
Aug.	11,239	9,950	8,571	8,100	—4,123	—3,285	1,289	18.7	.4	1,273	34
Sept.	11,284	9,692	8,305	7,700	—2,344	—1,906	1,592	13.6	.0	1,568	38
Oct.	12,667	10,549	8,592	8,800	—2,057	— 519	2,118	19.4	2.7	2,092	43
Nov.	10,558	8,741	8,326	8,500	+ 200	+1,438	1,817	20.1	.8	1,778	58
Dec.	9,311	7,458	8,614	7,900	+1,215	+1,853	1,853	19.2	1.1	1,789	82
1924											
Jan.	10,063	8,298	8,624	7,100	+ 859	+ 697	1,765	15.3	1.4	1,716	63
Feb.	9,454	7,882	8,078	7,150	+ 483	+ 371	1,572	13.9	4.3	1,538	44
Mar.	9,387	7,937	8,646	7,200	+ 237	+ 175	1,450	24.9	.8	1,426	48
Apr.	8,633	7,538	8,377	6,800	— 72	— 534	1,095	4.0	.0	1,038	61
May	8,871	7,860	8,667	6,700	— 811	—1,373	1,011	.6	.9	976	35
June	8,749	7,522	8,398	6,400	—1,318	—2,180	1,227	1.2	.9	1,174	53
July	9,543	8,712	8,688	6,800	—2,594	—3,056	831	1.5	1.2	789	42
Aug.	11,014	10,021	8,699	7,400	—3,170	—3,032	993	2.9	.0	949	47
Sept.	11,699	10,188	8,429	7,500	—1,948	—1,710	1,511	.4	.4	1,463	48
Oct.	12,691	10,782	8,720	8,675	—1,364	+ 49	1,909	.0	.0	1,852	57
Nov.	10,299	8,646	8,449	9,100	+ 273	+2,111	1,653	.1	.0	1,616	37
Dec.	9,897	8,387	8,742	7,700	+1,870	+2,308	1,510	.1	.0	1,452	58
1925											
Jan.	11,006	9,946	8,752	6,700	+2,515	+1,953	1,060	.1	.7	988	71
Feb.	9,211	8,235	7,915	7,400	+3,009	+3,147	976	.3	.0	936	40
Mar.	8,197	6,772	8,774	6,850	+3,879	+3,467	1,425	.1	2.5	1,387	36
Apr.	7,556	6,544	8,501	6,400	+2,327	+1,465	1,012	.7	.1	955	58
May	7,809	7,063	8,795	6,200	+ 570	— 492	746	.0	.0	690	56
June	8,601	7,742	8,522	5,700	— 662	—2,224	859	.4	.0	820	39
July	9,806	8,986	8,816	5,900	—1,642	—3,004	820	.1	.1	775	45
Aug.	10,413	9,503	8,827	7,700	—3,272	—2,834	910	.5	3.7	874	33
Sept.	11,126	10,272	8,552	7,400	—2,296	—2,158	854	.3	.0	800	54
Oct.	12,000	10,938	8,848	8,400	—1,576	— 438	1,062	2.6	1.2	1,012	49
Nov.	10,190	9,255	8,573	7,900	+1,014	+1,652	935	4.0	1.6	872	65
Dec.	9,976	8,928	8,870	7,800	+1,796	+2,334	1,048	2.1	1.8	1,009	39
1926											
Jan.	9,521	8,794	8,880	6,900	+2,754	+2,392	727	1.7	.5	676	52
Feb.	8,180	7,484	8,030	7,000	+2,568	+2,306	696	.5	.0	647	49
Mar.	9,068	8,335	8,902	6,600	+2,422	+1,760	733	1.0	.7	695	38
Apr.	8,301	7,417	8,625	6,100	+2,355	+1,193	884	1.2	.9	834	50
May	8,099	7,362	8,923	6,500	+ 747	— 15	737	.9	.2	679	59
June	8,709	8,010	8,645	6,400	— 714	—1,576	699	2.4	.4	667	34
July	10,485	9,637	8,944	6,500	—1,449	—2,211	848	1.1	.3	793	56
Aug.	11,430	10,027	8,955	7,660	—1,916	—1,518	1,403	.2	.1	1,363	40
Sept.	11,835	10,218	8,676	8,300	—1,484	— 446	1,617	.3	.2	1,560	57
Oct.	11,610	10,181	8,976	8,500	— 142	+1,096	1,429	.1	.3	1,385	44
Nov.	10,368	8,968	8,697	8,700	+ 863	+2,301	1,400	.2	.8	1,344	55
Dec.	9,587	8,317	8,997	8,000	+1,834	+2,572	1,270	.1	.0	1,208	62
1927											
Jan.	9,263	8,179	9,008	6,700	+2,454	+1,892	1,084	.8	.1	1,009	76
Feb.	8,559	7,654	8,146	7,500	+ 825	+1,063	905	.6	.6	874	31
Mar.	9,527	8,598	9,035	7,050	+ 783	+ 571	929	.3	.0	867	62
Apr.	8,795	7,733	8,749	6,500	+ 901	+ 139	1,062	.1	.0	1,016	46
May	8,987	7,825	9,051	6,600	— 215	— 877	1,162	.1	.5	1,099	63
June	8,989	8,075	8,769	6,300	—1,141	—2,103	914	2.1	.7	863	52
July	8,849	8,013	9,072	6,250	—1,785	—2,797	836	.1	.0	788	48
Aug.	10,179	9,082	9,083	6,800	—3,394	—3,856	1,097	.1	.7	1,052	44
Sept.	11,033	9,716	8,800	7,300	—3,895	—3,857	1,317	.1	.0	1,280	37
Oct.	11,523[b]	10,023[b]	9,104	8,490	—4,169	—2,941	1,500[b]	...	...	.....	..
Nov.	.....	.....	.....	7,900	—2,660[b]	—2,022[b]	.....	...	...	.....	..

* For explanatory notes see p. 100.

[a] Deviations from 4-year average, July 1923–June 1927. [b] Preliminary.

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OF THE

FOOD RESEARCH INSTITUTE

VOL. IV, NO. 3 JANUARY 1928

SURVEY OF THE WHEAT SITUATION

AUGUST TO NOVEMBER, 1927

Developments in wheat trade and prices in the period under review were not spectacular, especially in view of normal growth in production, consumption, and trade. Progress of the Canadian crop was the factor of major influence. The crop was sown late; hence danger of damage from rust and frost was unusually great, and world markets responded sharply to daily weather reports. Progress proved favorable for a large yield, and world prices declined, reaching by November the lowest level since 1923. International trade was of large volume during August–November, partly because of a delayed crop and wet harvesting weather in Europe. With ocean freight rates at normal levels, wheat and flour moved much more freely than in the same months of 1926.

The world wheat crop, exclusive of Russia and China, now appears the largest in post-war years except 1923; but it is little above the line of normal growth. In distribution between exporting and importing areas it differs little from the crop of 1926; again the international statistical position is fairly easy, and slightly easier than in 1926–27. Europe and the Orient have somewhat larger crops of wheat and wheat substitutes this year than last; exporting countries have slightly larger supplies available for export (partly because of larger inward carryovers), despite defections in Russia, the Danube countries, and Australia. We estimate the probable volume of international trade, as measured by net exports, at 825 million bushels. North America promises to provide an extraordinarily large proportion of the total. No substantial reasons now appear for anticipating material departures from the November–December level of world prices. Carryovers are likely again to be increased, though not so extensively as in 1926–27.

STANFORD UNIVERSITY, CALIFORNIA

January 1928

WHEAT STUDIES

OF THE

FOOD RESEARCH INSTITUTE

The central feature of the series is a periodic analysis of the world wheat situation, with special reference to the outlook for supplies, requirements, trade, and prices. Each volume includes a comprehensive review of the preceding crop year, and three surveys of current developments at intervals of about four months. These issues contain a careful selection of relevant statistical material, presented in detail in appendix tables for reference purposes, and in summary form in text tables and charts.

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FOOD RESEARCH INSTITUTE

STANFORD UNIVERSITY, CALIFORNIA

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Carl Lucas Alsberg — Joseph Stancliffe Davis

Alonzo Englebert Taylor

The Food Research Institute was established at Stanford University in 1921 jointly by the Carnegie Corporation of New York and the Trustees of Leland Stanford Junior University, for research in the production, distribution, and consumption of food.

SURVEY OF THE WHEAT SITUATION

AUGUST TO NOVEMBER, 1927

The present survey covers the first third of the international crop year—a crucial period in the development of important wheat crops. The events of this period provide a reasonable basis for appraising the outlook for world wheat trade and prices for the crop year as a whole, at least until May, when the progress of new crops begins to exert an influence unpredictable in December. This year the outlook is perhaps somewhat less clear than usual because of uncertainties respecting the crops of Europe and Canada, which were harvested under conditions that render standing crop estimates open to question; but certain conclusions may be drawn with reasonable assurance. Crop statistics, trade, and prices during the first four months, at least after the Canadian crop was secured, bear witness that the present crop year is in most respects normal, conspicuously less eventful than 1924–25 or 1925–26, and somewhat less striking than 1926–27.

In Canada, however, crop developments have been even more pronounced and potent. Seeding was delayed much beyond the normal date, and acreage was slightly reduced. The crop, though planted in soil abundantly supplied with moisture, was subject to exceptional risk of frost damage because of the unusual lateness of sowing. Rust appeared; and throughout August and early September the markets of the world responded sharply to crop and weather reports. Despite extensive damage from both menaces, the harvest proved distinctly large —perhaps smaller only than the bumper crop of 1923, though downward revisions of present estimates are not unlikely. The Canadian crop is of relatively poor quality; there is little grain of the higher grades, and much tough wheat. Nevertheless assurance of the Canadian crop has raised the total for North America to the highest level since the bumper crop of 1915.

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The United States crop of spring wheat turned out of record size for post-war years despite delayed seeding and damage from rust; but the winter-wheat crop proved to be only average. Drought throughout the growing season curtailed the outturn in Australia. Argentina, with a favorable growing and harvesting season and the largest planted area in her history, apparently secured a crop little smaller than the record outturn of 1923. Europe, Russia excluded, apparently has harvested a crop slightly above average in size in spite of a distinctly unfavorable harvesting period in the northwestern countries.

Detailed official data summarized in Table 1 (p. 104), though as yet tentative, indicate a world crop (exclusive of Russia and China) over 100 million bushels larger than that of 1926, and approximately equal to the bumper crop of 1923. Russia, however, has apparently a smaller crop than last year. The Northern Hemisphere (ex-Russia and China) apparently has considerably more wheat this year than last, the Southern Hemisphere slightly less. But the large world outturn can hardly be regarded as much above normal, in view of the upward trend of wheat production and consumption since the war. In distribution between importing and exporting countries, the 1927 crop is about normal, similar to that of 1926 and 1923, and far different from the distribution of 1924 or 1925. As in 1926, bumper crops or crop failures are alike conspicuously absent. Among the several exporting countries, by comparison with 1926–27, the present crop year witnesses smaller crops in the Danube countries, Russia, and the Southern Hemisphere offset by larger crops in North America. On the whole the quality of the world's crop appears neither distinctly good nor distinctly poor, though perhaps on the average not so good as in 1926.

International trade was nearly of record volume in the first third of 1927–28, but the high figure is the less noteworthy in view of normal growth. Certain European importing countries, despite large carryovers out of 1926–27, were forced to purchase large supplies in August–September because of late harvests and damp grain in northwestern Europe. The movement from Canada was delayed by the late harvest, but Pacific Coast shipments from the United States were exceptionally large. Rapid marketing by American farmers, especially of spring wheat, resulted in a heavy accumulation of visible supplies. By the end of November, when the large Canadian crop was moving in great volume, world visible supplies had reached the highest figures in post-war years. Faced with the steady accumulation of supplies, purchasers of wheat and flour showed no disposition to accumulate stocks in advance of requirements, though buying became more active in November.

Wheat prices in the world's principal markets responded sharply to the frost in Canada on August 7, and thereafter declined as the Canadian crop showed favorable progress. By October the level of prices was the lowest for a similar period since 1923. Cash prices in Canada, however, did not reach such low levels relative to preceding years as were recorded in the United States and the United Kingdom, largely because Canadian wheat of the higher grades is at a premium for the second successive year. Toward the end of November, prices in most markets were somewhat below the prices prevailing last year, but not so much lower as in October, when last year's prices were raised by the situation in ocean freight rates. In France and Italy, for special reasons, the August–November period witnessed much lower prices this year than last. In the United States, large crops of hard red spring and durum wheats led to relatively low prices, while soft red winter wheat, in short supply, commanded a premium as in 1925–26.

The international statistical position now appears much easier than in 1924–25 and 1925–26, but not so easy as in 1923–24. Comparisons with 1926–27 are difficult on account of uncertainty respecting crop estimates in both years. On the whole, however, only slight differences are to be observed; the position in 1927–28 is fairly easy, and probably slightly easier than last year. Despite defections in Russia, the Danube countries, and Australia, the exporting countries of the world apparently have slightly larger supplies available for export; and importing countries require a little less wheat. We expect international trade, as measured by net exports, to attain a figure of about 825 million bushels,

TABLE 1.—WHEAT PRODUCTION IN PRINCIPAL PRODUCING AREAS, PRE-WAR AND POST-WAR*

(Million bushels)

Year	United States	Canada	Soviet Russia	Lower Danube[a]	Other Europe	North Africa	India	Japan, Chosen	Northern Hemisphere ex-Russia	Argentina	Australia	Southern Hemisphere	World ex-Russia
1920.....	833	263	...	172	775	71	378	41	2,550	156	146	350	2,900
1921.....	815	301	...	212	1,004	98	250	40	2,727	191	129	376	3,103
1922.....	868	400	...	224	815	72	367	40	2,801	196	109	354	3,155
1923.....	797	474	...	260	989	106	372	35	3,051	248	125	427	3,478
1924.....	864	262	...	204	847	85	361	37	2,673	191	165	407	3,080
1925.....	676	411	713	305	1,096	105	331	40	2,976	191	115	359[b]	3,335[b]
1926.....	831	410	810	298	909	90	325	39	2,915[c]	221	161	435[b]	3,350[bc]
1927.....	872	444	...	277	977[d]	102	334	38	3,057[cd]	240	115	...	.....
Average													
1909–13...	690	197	759	330	1,018	92	352	32	2,724	147	90	280	3,004
1922–26...	808	391	...	258	931	92	351	38	2,884[c]	209	135	396[b]	3,280[bc]

* Summarized from most recent official data for individual countries (see Appendix Table I), as reported by the U.S. Department of Agriculture, supplemented in a few cases by our own rough estimates. Totals exclude China, Turkey in Europe, Brazil, and a number of small producers. All estimates are for territory within post-war boundaries.

[a] Hungary, Bulgaria, Roumania, Jugo-Slavia.

[b] Includes our estimate for Peru.

[c] Includes our estimate for Cyprus.

[d] Includes our estimates for Denmark, Esthonia, Scotland, and Ireland.

some 25 million bushels less than in 1926–27 and about the same as in 1923–24, but more than in any other year.

In the present position we see no factors that would materially affect the level of world wheat prices prevailing in November–December. If the present position remains unchanged, the level of world wheat prices, as reflected in cash or futures prices in the United Kingdom and the United States, promises to prove lower this year than last, especially in the United Kingdom, where the advance in ocean freight rates last year raised import prices. Canadian wheat of the higher grades will probably command higher prices this year than in 1926–27. In the United States, the premiums already established on soft red winter wheat and all wheat of high protein content, and lower prices on durum and other spring wheats, will probably continue. Carryovers out of 1927–28 will perhaps be increased somewhat, especially in the United States; but no such increase as occurred last year is likely.

I. CROP DEVELOPMENTS, AUGUST–NOVEMBER

Wheat trade and prices during August–November have been dominated by changes in crop prospects in Canada, where the outturn has proved larger than was expected by the most optimistic in early August. Official estimates of the United States crop were increased slightly during the four months under review. The Argentine and Australian crops, though not yet made, appear to have neither exceeded nor fallen below expectations. No notable changes have been recorded in the crop estimates for India and North Africa. On the whole, chiefly on account of the progress of the Canadian crop, larger world supplies of wheat now appear available than were in prospect four months ago.

The United States

Crop developments in the United States during August–November have had comparatively little market influence, though perhaps slightly more than usual on account of the lateness of the spring-wheat crop and the presence of rust infestation. The official estimate of winter-wheat production has remained unaltered since August, though some private statisticians have reduced their estimates slightly. With respect to spring wheat, the official estimates of 298 million bushels as of August 1 was raised to 308 million as of September 1, and to 314 million as of October 1. Private statisticians (Bryant excepted) did not concur in the September increase; and the official figure took many traders by surprise, since reports had been current that rust infestation had reduced spring-wheat yields during August. The official estimate as of October 1 (issued October 10) also was unexpectedly high; early in the month private statisticians had published estimates ranging from 288 to 300 million bushels, whereas the official figure was 314 million.[1]

According to the official estimate now standing, the United States wheat crop reaches 872 million bushels, 41 million larger than the crop of 1926. A distinctly larger crop has not been harvested since those of 1918 and 1919. In continuation of an upward trend in the past four years, the area harvested, 58.6 million acres, is larger than in the preceding three years, though smaller than in 1918–23. Yield per acre, 14.9 bushels, is the highest in post-war years except 1924, with spring-wheat yields relatively higher than winter. The production estimate, however, cannot be unreservedly accepted. Significant evidence indicates that the crops of 1925 and 1926 were underestimated by 30 million bushels or more;[2] on the other hand, competent observers regard the 1927 estimate, in total, as too high. It is at present impossible to adjudge the facts precisely; but the December official estimate was this year supplemented by half a million questionnaires sent directly to farmers, and this procedure may have tended to correct a possible bias existing in 1925 and 1926.

[1] The course of official and private estimates of spring-wheat production, in million bushels, was as follows:

Date	Official	Bryant	Cromwell	Murray	Snow
Aug. 1..	298	274	288	300	309
Sept. 1..	308	284	281	286	294
Oct. 1..	314	288	290	288	300
Dec. 1..	319	...	312	294	...

[2] See Wheat Studies, IV, 19.

The significant features of the distribution of the 1927 crop by classes[1] are the huge outturns of durum and Pacific white wheats, the exceptional outturn of hard red spring, and the poor crop of soft red winter. The crop of hard red winter is well above average in size, but much smaller than the huge crop of 1926. In quality the crop as a whole is apparently above average. Weight per measured bushel of winter wheat is reported as 58.6 pounds as against a 10-year average of 58.2; of spring wheat, the 1927 figure is 58.3 pounds as against a 10-year average of 57.1. Yet, according to official data in which a figure of 100 represents a crop of high medium grade, the winter-wheat crop is below the 10-year average (88.5 as against 90.1), though the spring-wheat crop is above (88.1 as against 86.5). Winter wheat is considerably poorer this year than last in both weight per bushel and protein content; spring wheat is perhaps better in weight, but probably lower in protein content.[2] Rather large quantities of wheat were damaged by excessive rains at harvest in parts of the Great Plains, and also in the Pacific Northwest; but the United States crop as a whole is this year exceptional among other large Northern Hemisphere crops for its comparative freedom from damp grain.

[1] See Appendix Table IX in WHEAT STUDIES, IV, 49. The distribution there shown does not apply to the December official estimate; but corrections will probably not alter the broad facts.

[2] Data apart from the U.S. Department of Agriculture's estimates of test weight are not available for the spring-wheat crop as a whole. For North Dakota, the leading producer, the following figures have been issued by C. E. Mangels *et al.*, in *North Dakota Agricultural Experiment Station Bulletin 213*, November 1927, p. 5:

Crop of	Common wheats		Durum wheats	
	Test weight *(lbs. per bu.)*	Protein content *(per cent)*	Test weight *(lbs. per bu.)*	Protein content *(per cent)*
1924	60.9	11.33	....	.....
1925	58.8	12.30	....	.....
1926	59.1	14.23	61.3	14.08
1927	57.7	11.82	60.1	11.21

According to these data, protein content in 1927 is much lower than in 1926, though fully average. But the figures above do not agree with the official data on test weights, which are 57 rather than 59.1 pounds in North Dakota in 1926, and 58 rather than 58.3 pounds in 1927. The official data, while less accurate for specific samples, presumably disclose the broad facts better than the experimental data, which were necessarily based upon a narrower range of samples.

[3] According to the final crop report of the Canadian Pacific Railway, issued November 14, threshing was complete in Manitoba, 95–100 per cent complete in Saskatchewan, 90–95 per cent in northern Alberta, and 75–80 per cent in southern Alberta.

CANADA

The vicissitudes of the Canadian crop dominated the world's markets practically throughout the period under review. Seeding was greatly delayed in the spring, rust appeared in the summer, and harvest was inevitably late. The possibility of serious frost damage before the crop could mature was more of a menace than usual. During August, rust did considerable damage in Manitoba and eastern Saskatchewan; and a frost occurred on August 7. Beyond question the wheat plant was seriously damaged over a fairly wide area, but even at present the effects are not measurable. An ample supply of subsoil moisture, good rains during the growing season, and weather cool enough to prevent excessive damage from rust were factors which proved sufficiently favorable to assure a large crop despite the ravages of frost and rust. Cutting was practically complete by the end of September, despite much interruption from rain. Threshing was seriously interrupted by rain and some snow in the first two weeks of October. In mid-November winter weather put a stop to threshing before all wheat was removed from the fields, especially in southern Alberta.[3]

In view of the good supply of subsoil moisture and the favorable weather of July, observers were anticipating a distinctly large crop in Canada, 400 million bushels or more, as early as August 1—always on the assumption that early frost would not occur. Yet the late seeding and consequent danger of frost damage led traders in general to believe that the chances were against a large crop; and the conviction, supported by the frost of August 7, was only gradually weakened, to be finally reversed as the crop approached maturity. Private statisticians on September 1 were forecasting the outturn of the Prairie Provinces alone between 400 and 434 million bushels, well above their August 1 estimates despite the frost; and the official figure of 459 million bushels for all Canada as of September 1 (issued on September 12) was higher still.

The rainy weather throughout September and early October, and unfavorable threshing returns from some districts, gave rise to a reduction of 14 million bushels in the November official estimate. Reductions of 4.7 and 18.2 million bushels respectively in the estimates for Manitoba and Saskatchewan were partially offset by an increase of 9.7 million for Alberta. The crop of Alberta now appears to be much the largest in her history.

Although reputable estimates now standing range only from 425 to 450 million bushels,[1] the size of the crop is still uncertain. The final official estimate will not appear until January.[2] An unknown quantity of wheat still remains unthreshed; on the other hand, the final official estimates appear to have been appreciably below the truth for four years past, and may prove so again. But the Canadian crop is clearly of large size, probably the largest ever harvested except for the huge crop of 1923.

In quality, however, the Canadian crop is apparently poor, even by contrast with the crop of 1926. Table 2 provides comparisons in detail. The official estimate of quality as of September 30 gave a figure of 97 per cent as compared with 96 per cent in 1926, but during September–November only 1.7 per cent of the inspections of the Western Division has graded No. 1 Northern Manitoba, and only 10.1 per cent No. 2. Even last year, when these grades were distinctly scarce, the proportions were higher. There is perhaps less tough wheat this year than last; but there is an exceptionally large proportion of the straight grades No. 3 and below. Wheat entirely unfit for milling—rejected, feed, and condemned—is not, however, present in unusual quantity. Frost and rust clearly reduced grades in all three of the Prairie Provinces, though apparently less in Alberta than elsewhere. It is further reported that Canadian wheat is lower than usual in protein content. The significance of low grades is somewhat diminished by the fact that millers are able to fan out frosted kernels light in weight, thus obtaining a residue of milling wheat of high quality.

TABLE 2.—PERCENTAGES OF VARIOUS GRADES OF CANADIAN HARD RED SPRING WHEAT TO TOTAL WHEAT INSPECTED IN THE WESTERN DIVISION, SEPTEMBER–NOVEMBER 1923–27*

	1923	1924	1925	1926	1927
No. 1 Northern...	40.2	22.8	28.4	14.1	1.7
No. 2 Northern...	24.6	19.8	30.8	24.2	10.1
No. 3 Northern...	20.5	19.1	13.7	9.3	24.2
Nos. 4, 5, 6 Northern	9.0	27.1	4.2	4.7	20.2
Feed, etc.[a].....	3.7	1.6	1.7	.7	1.3
No grade[b].....	1.1	7.2	17.8	38.4	36.1
Total above.....	99.1	97.5	96.6	91.4	93.6
Total inspections.	100.0	100.0	100.0	100.0	100.0

* Data from *Canadian Grain Statistics.*

[a] Includes also rejected, condemned, and no established grade.

[b] Wheat containing a higher proportion of moisture than wheat of numbered grades. Aside from higher moisture content, it may be of as good quality as the numbered grades, and is always better than feed, rejected, or condemned wheat.

EUROPE

Crop developments in Europe during August–November have naturally varied from country to country. On the whole, the harvesting and early threshing season was distinctly unfavorable in most of the countries where wheat is harvested in late August and in September; and the European crops in the aggregate now appear somewhat smaller than seemed probable in August. But notable reductions of crop estimates have been made only in Italy, Roumania, and Jugo-Slavia. Other European countries have harvested crops as large as was earlier expected; but larger quantities of the harvested crops in northwestern Europe are unfit for milling than appeared probable as harvest began.

Most of the countries of central and eastern Europe harvested distinctly good crops. Greece, Bulgaria, Hungary, Austria, Poland, and Czecho-Slovakia secured outturns not

[1] The latest official and unofficial estimates, for the Prairie Provinces only, are as follows, in million bushels:

Manitoba Free Press (September 17)	424
Bryant (October 1)	400
Cromwell (October 1)	422
Murray (October 1)	417
Northwestern Grain Dealers' Assn. (October 1)	409
Official (November 1)	419

[2] The final estimate, however, has not differed from the October 31 estimate by more than 11 million bushels during the past six years. See Appendix Table XI, WHEAT STUDIES, IV, 50.

greatly inferior to the record post-war crops of 1925, and well above those of last year. Roumania and Jugo-Slavia, however, apparently suffered from dry weather in the growing season. The Roumanian crop of 97 million bushels is of mediocre size, and 14 million bushels less than in 1926; the Jugo-Slavian of 57 million is the smallest since 1922. In the Danubian states, Austria, and Greece, quality is said to be excellent; Hungary in particular has the best wheat in post-war years.[1] In more northerly countries quality is probably relatively poorer, but still good. None of these countries experienced the unfavorable harvesting weather common to western Europe.

The important Italian crop is now officially estimated as of only 196 million bushels, the smallest in the past five years except 1924.[2] An earlier official estimate placed the crop at 215 million bushels, but storms, hot winds, and drought during the late growing season apparently did more damage than had earlier been supposed. Quality, however, is said to be excellent. The Spanish crop, of which little is known, is apparently, like the crop of 1926, about of average size, and considerably below the good outturns of 1923 and 1925.

The volume of wheat production in the British Isles, France, Holland, Belgium, Germany, and Scandinavia is less certain. These countries suffered from excessive rainfall practically throughout late August and September, though there were of course spells of satisfactory harvesting weather, notably in the first third of September. Apparently English farmers encountered the greatest difficulties, German the least. Some grain was lost by shedding in the fields, some by sprouting; and much wheat was stacked, or garnered, or threshed while unfavorably damp. Harvesting operations in general were delayed, and crops had reached maturity later than usual on account of a cool and wet growing season. According to official estimates current in early December, the countries of northwestern Europe have secured a wheat crop of about 490 million bushels, the second largest crop of the past five years, some 70 million larger than the crop of 1926, but 65 million below the large crop of 1925. The increase over 1926 is due chiefly to the larger crop in France, which is officially estimated at 284 million bushels as compared with 232 million last year. Last year's figure, however, appears somewhat too low; and the accuracy of the estimate for 1927 remains to be seen.[3] According to official data, the German crop of 114 million bushels is slightly the largest of post-war years except 1925, and 18 million larger than in 1926.[4] Some German wheat was unmillable in 1926; a still larger amount is apparently unmillable this year. Nevertheless it seems probable that the countries of northwestern Europe harvested larger crops of sound wheat than in 1926, though probably not 70 million bushels more, as the official data would indicate when uncorrected for a probable understatement in 1926 or for unmillable wheat in 1927. It is to be remembered, however, that the wheat crops of 1926 were by no means of good quality in northwestern Europe, France excepted.

For Europe (ex-Russia) as a whole, the wheat crop of 1927 is thus of rather better than average size, distinctly larger than the crops of 1922 and 1924, distinctly smaller than the crop of 1925, and not far different

[1] An interesting and heated discussion appears in Hungarian newspapers regarding the relative quality of Hungarian and North American wheats. Importers of Hungarian wheat insist that even this year's crop of excellent quality is no more satisfactory for milling and baking purposes than No. 3 Northern Manitoba or No. 2 Hard Winter. Many Hungarians feel that it is equal to No. 1 Northern Manitoba, and ought to command equally high prices; and the press is filled with comments on the general "conspiracy" of consuming countries to depress Hungarian wheat prices.

[2] Some observers, however, regard all Italian crop estimates issued after the opening of the "Battaglia del Grano" in 1925 as over-optimistic. Checks on the estimates are not yet feasible; and for the present the official figures must be accepted.

[3] For evidence of an official underestimate of the French crop of 1926, see WHEAT STUDIES, IV, 44. It is of interest to observe that private estimates of the 1927 crop range higher than the official. The estimate of the *Bulletin des Halles,* usually a reliable authority, is for 292 million bushels, of which 18 million bushels is regarded as unfit for milling. M. Ernest Sicot's estimate, issued September 12, was for 329 million bushels of sound wheat. It is of interest to observe that M. Sicot has since been indicted under article 419 of the penal code. In view of the negligible opposition registered to an advance of the tariff from 18.2 to 35 francs, the low level of French prices, and the official underestimate of the crop of 1926, we are disposed to assume that the official estimate for 1927 is conservative rather than liberal.

[4] A revised estimate of the Prussian crop, issued early in December, suggests that the German crop somewhat exceeds 114 million bushels.

from the crops of 1923 and 1926. The European supply situation of 1927–28 is easier than in 1926–27, partly because carryovers into 1927–28 were on the whole the larger of the two, and partly because crops of the principal wheat substitutes, rye and potatoes, are much larger. According to official data summarized in Table 3, the European

TABLE 3.—EUROPEAN (EX-RUSSIAN) GRAIN AND POTATO CROPS, 1920–27*

(Million bushels)

Year	Wheat	Rye	Potatoes	Corn	Barley	Oats
1920.....	947	532	3,351	520	551	1,478
1921.....	1,216	758	3,078	393	566	1,509
1922.....	1,039	713	4,803	426	602	1,542
1923.....	1,249	824	3,864	475	668	1,814
1924.....	1,051	651	4,216	591	577	1,622
1925.....	1,401	938	4,756	627	694	1,794
1926.....	1,208	746	3,835	663	691	1,913
1927.....	1,253	830	4,514	488	671	1,840
Average						
1909–13...	1,348	976	4,162	528	701	1,931
1922–26...	1,190	774	4,295	556	646	1,737

* Summarized from most recent official data for individual countries, as reported by the U.S. Department of Agriculture. Excludes a few minor European producers. Pre-war averages are estimates for territory within present boundaries, and include 2-year or 4-year averages for a few countries. Figures for 1927 partially estimated.

rye crop exceeds that of 1926 by over 80 million bushels,[1] and the potato crop of 1927 is nearly 680 million bushels larger than last year's. Current estimates, however, may be revised downward, since the unfavorable weather affecting wheat harvest was injurious to rye and potatoes as well. Corn is a poor crop this year, principally in the Danube countries where drought reduced yields, and outturns of barley and oats, though well above average, fall below those of 1926.

Official estimates of Russian crop production have not yet appeared, and the situation is not clear. Despite a large acreage and favorable reports during the growing season, collections of grain[2] have run smaller than in 1926; and wheat exports also, so far as their volume is indicated by Broomhall's shipments data, have been small. These facts suggest either smaller wheat crops than were harvested in 1925 and 1926, or unwillingness of farmers to part with their grain at current prices, or probably both factors combined. On the other hand, there have been no reports of distinct shortage of grain supplies. Observers are agreed that heavy exportation from Russia is unlikely to occur in 1927–28, and crop developments in Russia have exerted negligible market influence this year.

[1] An official revision of the Prussian estimate of rye production, issued early in December, gave a figure about 15 million bushels lower than the earlier estimate.

[2] Separate reports for the several grains have not been issued.

[3] Official estimates of wheat acreage have been raised from 19.45 million acres in August to 19.70 million in November.

SOUTHERN HEMISPHERE WHEAT CROPS

Crop developments in the Southern Hemisphere during August–November were on the whole less noteworthy and of less influence on international markets than in the two preceding years. In both Argentina and Australia the sowing of wheat in April–June was hampered by drought. Nevertheless late rains permitted a record area to be sown in Argentina,[3] and the area sown in Australia fell only 60 thousand acres below the record figure of 1926.

It early became apparent that the Australian crop would prove relatively small. Rainfall was deficient even in August except in Western Australia; and September, when good supplies of moisture are apparently essential to heavy wheat yields, was a month of light precipitation in all states, though Western Australia was again favored. Early unofficial forecasts of production ranged approximately between the low figures of 95–110 million bushels. October and November were months of heavier rainfall, but observers agreed that only a small crop could be harvested, and estimates were raised but slightly. The first official forecast of the crop, issued early in October, was for a crop of 115 million bushels. According to present indications, the crop falls far below the large crops of 1926 and 1924, but it equals the crops of 1925 and perhaps 1923. As harvest progressed in December, unofficial observers tended to increase their estimates further; and official revisions appear more likely to be above than below the estimate now standing. Of the several states, Western Australia has an excellent crop; production is relatively the lowest in New South Wales.

The Argentine crop matured under approximately normal conditions. The winter was abnormally warm. Rainfall was light, but not exceptionally so, during most of August and September. Toward spring, in late September and October, the moisture supply was ample. Spring came slightly late, and consequently the maturity of the crop was somewhat delayed. Frosts occurred in some regions on November 7, giving rise to some uneasiness in foreign markets; but wheat was not damaged in the particular areas visited.[1] November weather was favorable for maturing the crop, despite some complaints of rust infestation. Harvest began in the earlier regions a little after Mid-November, somewhat later than usual. The official estimate of production, issued December 16, was for 240 million bushels. European traders had apparently counted on a crop of about this size, though American traders had expected a lower figure. If the current estimate proves accurate, a larger crop has not been harvested except in 1923. But the good outturn has resulted from large acreage rather than high yield per acre.

On the basis of official forecasts, Australia and Argentina combined have harvested a crop of 355 million bushels, some 27 million below the record outturn of 1926. The quality is unknown, but harvesting weather in both countries has apparently been such as to result in wheat of average quality or better. Early threshings in Argentina have shown high test weight per bushel.

II. MARKETING AND STOCKS

Delayed crops and the wet harvesting weather made for a restricted movement of wheat from farms to markets in northwestern Europe and Canada in the early part of the period under review. Thereafter the movement became very heavy, principally because farmers sought to dispose of damp grain. In Europe the movement has differed from country to country; but the liberal marketings in Italy and France have been of special significance. In the United States farmers have apparently marketed with unusual freedom. By the end of November commercial stocks of wheat ran very high practically throughout the Northern Hemisphere, in part because the marketings were large, but in part because purchasers of wheat and flour, faced with ample supplies and declining wheat prices, have not hastened to accumulate stocks.

European Marketing

During August–November the movement of wheat from farm to market in European countries is of marked significance in its effect upon prices of domestic wheats. In countries like Germany, France, and Italy, where high tariffs are in force but where native crops provide the major portion of the annual wheat supplies, heavy autumnal marketing will occasionally depress domestic wheat prices below the prices of imported wheat, duty paid, though the domestic crop may not be large enough to maintain this relationship for more than a few months of the year. Restrained marketing, on the other hand, may result in relatively high prices for domestic wheat for a few weeks or months. In general, European wheat producers, like producers in all other countries, market the bulk of their wheat in the months immediately succeeding the harvest; but, perhaps because grain is commonly stored under cover, unthreshed, the seasonal course of marketing in European countries apparently varies from year to year more widely even than it does in North America.

Although statistical information is deficient and little can be said with assurance, it appears that in practically all continental countries farmers have been dissatisfied with prices this year; and except for early heavy offerings of damp grain in northwestern Europe and of sound grain in Italy, the movement from farms has not been notably rapid. This is in sharp contrast with last year, when high ocean freight rates in October and November led millers to seek for domestic wheat, and the course of prices was upward rather than downward.

Italian farmers were apparently somewhat inclined to restrict their offers in July and early August, and loans by banks on

[1] *Times of Argentina*, November 7, 1927, p. 20.

stored wheat may have facilitated holding for a time. But the outward carryover of old-crop wheat was large, and in mid-August, with declining world prices, marketings became heavy and continued so into November. The heavy receipts depressed prices below the prices of import wheat and Italian farmers have been dissatisfied.

In northwestern Europe, where the crop was late, marketings were naturally small in August in all countries. Subsequently, at least in France, Germany, Holland, and Belgium, marketings were distinctly large for several weeks. Farmers wished to dispose of their damp grain as rapidly as possible rather than run the risk of spoilage. In France the quantities marketed in September and October appear to have been abnormally large, perhaps in part because large carryovers of old-crop wheat swelled the total; by mid-October the Producers' Association pointed out that farmers themselves were largely to blame for current low prices, and advised producers to allow their wheat to dry, and to market more slowly. The advice respecting marketing policy apparently had slight effect, for despite the preoccupation of farmers with fall plowing and seeding, offers seem to have continued liberal until the increase of the tariff to 35 francs on November 18. In November the quality of the wheat offered was considerably better than in earlier months, and stocks remaining in farmers' hands by December 1 probably consisted of sound wheat. By mid-November millers were finding the domestic wheat satisfactory for milling. As in France, the early heavy marketings in Holland, Belgium, and Germany consisted largely of damp grain. In these countries liberal offers did not begin until late September and October, since harvest was later; and the pressure of offers appears to have been less noteworthy than in France.

In England, where the proportion of damp grain was perhaps even larger than elsewhere, farmers' deliveries were small throughout all of August–November. As the following figures in thousand bushels show,[1] only two-thirds as much domestic wheat had been marketed during these months as in 1925 and 1926, when crops were about the same size.

To end of	1924	1925	1926	1927
Aug.	277	1,266	235	339
Sept.	1,491	4,140	2,739	1,756
Oct.	3,882	6,675	5,753	3,503
Nov.	4,737	9,552	9,545	6,007

It is of interest to observe, however, that deliveries in 1924 were smaller still. In that year also an exceptionally large portion of the crop was injured by wet weather at harvest.

In Hungary trade reports mention decided reluctance among farmers to part with their good wheat, and current discussions of a "conspiracy" among importers to pay less for Hungarian wheat than for North American wheats of similar quality may have fostered the tendency. In Jugo-Slavia, where the crop is short, farmers are reported to have restrained their offers in the expectation of better prices. In both countries, and in Roumania as well, stocks were said to be large early in November; but this may have been due to slow exportation rather than heavy marketing. In Spain, producers are reported to have marketed slowly.

North American Marketing

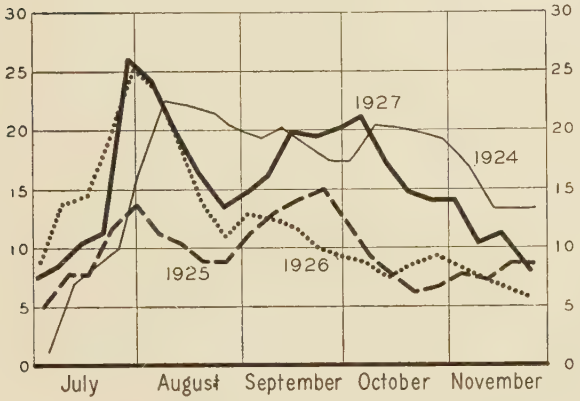
For the second successive year, American marketings of winter wheat were exceptionally heavy in July. This year, as appears from Chart 1 (p. 112), the movement began in volume somewhat later than last year, when the crop in the southwestern states was larger. Increasing use of the harvester-thresher "combine" apparently has advanced the effective maturity of the winter-wheat crop east of the Rocky Mountains, and perhaps the spring-wheat crop; the movement in July 1926 and 1927 contrasts sharply with the movement in 1924 and 1925. In view of the smaller winter-wheat crop east of the Rockies this year, the high peak of receipts at the end of July is especially noteworthy. This year farmers have apparently marketed even more freely than last. Spring wheat was also marketed promptly and freely; larger receipts this year than last in September–November were due chiefly to the larger spring-wheat crop, but farmers showed no disposition to hold back their wheat. Declining receipts

[1] Data from Broomhall's *Corn Trade News*.

in October were apparently due as much to a spell of exceptionally mild weather permitting field work, as to dissatisfaction with prices.[1] Producers of both winter and spring wheat have probably sold their wheat freely this year because prices tended downward; in 1924, when marketings were also large, financial pressure was a more important factor.

CHART 1.—WEEKLY WHEAT RECEIPTS IN PRIMARY MARKETS IN THE UNITED STATES, JULY–NOVEMBER 1924–27*

(Million bushels)



* Unofficial data compiled from *Price Current-Grain Reporter.*

From July to November, receipts at primary markets this year totaled 336 million bushels, the highest figure since 1924.[2] But comparisons are not especially significant, since receipts at primary markets on the Gulf or in the Pacific Northwest are not included in available statistics. Consequently the receipts figures shown in Chart 1 and Appendix Tables II and III do not indicate with precision the volume or course of the movement of wheat from farms in the United States as a whole. If data for receipts in these areas were available, it is probable that neither the seasonal course nor the total receipts would show such marked differences between the years 1924, 1926, and 1927 as now appear. This year the crop in the Pacific Northwest was about a fourth larger than in 1926, and indeed the largest since 1923.[3] Farmers are reported to have marketed this wheat rapidly, particularly because much grain was moist; and exports have run high.[4] For the United States as a whole, there is reason to suppose that the marketing movement July–November has been quite as large as the crop permits, and unusually rapid. Murray estimates that 72.8 per cent of the marketable wheat of the 1927 crop had been moved from farms by December 1, as compared with a normal of 67.1 per cent;[5] and the estimate appears reasonable despite a lower figure of receipts at primary markets in 1927 than in 1924.

In Canada, as in western Europe, the harvest was late and threshing operations were impeded by stormy weather. Receipts at country elevators in the Prairie Provinces did not exceed 7 million bushels until the last week in September—a figure smaller than receipts for the first week in September 1925 or the second week in September 1926, when harvest was also delayed. Receipts at Fort William and Port Arthur[6] continued far below normal until the second week of October; for the month of September 1927, only 8.6 million bushels were received, as against 32.8 million in 1926, and 45.7 million in 1925, though the crop exceeded 400 million bushels in each of these years. In October the movement from farms was moderately large; but the full size of the Canadian crop appeared only in November, when receipts at Fort William and Port Arthur were 71 million bushels, the largest since the bumper crop of 1923. On account of the restricted marketings in September and early October, however, the total receipts for the period August–September were the lowest in the past five years except 1924, when the crop was short. In spite of the huge crop in Alberta this year, receipts at Vancouver and Prince Rupert have not yet been large. The movement to the Pacific Coast will presumably increase in the winter months, not only because large quantities of wheat are available, but also because freight rates to the coast have been lowered.

By contrast with the relatively small total

[1] See *Northwestern National Bank Review* (Minneapolis), November 15, 1927.

[2] See Appendix Table II.

[3] See Appendix Table IX in WHEAT STUDIES, IV, 49.

[4] See below, p. 118, note 1.

[5] Monthly circular of Clement, Curtis & Co. (Chicago), December 8, 1927.

[6] See Appendix Tables II and III.

receipts, it is of interest to observe that stocks at the end of November in all positions were slightly higher even than those of 1926, when the situation in ocean freights had restricted the export movement. The data appear in Table 4. This year's figures

TABLE 4.—CANADIAN GRAIN IN STORE LATE IN NOVEMBER, 1923–27*

(Million bushels)

Last week in November	Total	Country elevators West. Div.	Interior elevators	Vancouver elevators	Fort William, Port Arthur	U.S. lake and Atlantic ports	Public elevators in the East
1923...	101.6	52.7	.5[a]	.8	19.8	16.3	11.5
1924...	73.7	24.3	2.5[a]	1.3	25.6	9.8	10.2
1925...	102.6	45.3	5.1	4.7	19.9	10.7	16.9
1926...	114.7	35.1	6.9	6.7	29.8	21.7	14.5
1927...	115.6	45.3	6.4	5.8	18.5	23.9	15.7

* Compiled from *Canadian Grain Statistics*, and adjusted to bring figures for country elevators in Western Division into the proper week. Stocks at Prince Rupert included in Vancouver figures.

[a] Figures prior to 1925 are less comprehensive than for later years.

are relatively high chiefly because November receipts were so large. That the movement from farms was delayed this year, especially by contrast with 1925, is evident from the large stocks reported in country elevators. On the other hand stocks at the terminals in Fort William and Port Arthur have been kept relatively low, while wheat has apparently been moved rapidly to positions in the United States. Thus far less congestion of terminal elevators with damp wheat has occurred this year than last.

VISIBLE SUPPLIES

The weekly course of the principal elements in visible supplies is shown in Chart 2 (p. 114), with comparisons for the three preceding years. As in 1926, the United States visible (Bradstreet's) reached its low point earlier than usual, at the end of June. The increase in July was not so rapid this year as last on account chiefly of a smaller winter-wheat crop and somewhat less favorable harvesting weather; but during August and September the course of visibles differed little between the three years 1924, 1926, and 1927, when crops were much larger than in 1925. During October and November marketings of spring wheat swelled the visible this year as compared with 1926, when the spring-wheat crop was much smaller. This year the visible has apparently been kept at so high a level partly by relatively restricted purchases of wheat by mills. Millers have not been encouraged to lay in stocks, because flour sales have been slow. According to our estimates of total flour stocks,[1] July stocks were about at the usual level for the month. But in August they were about a million barrels below the usual seasonal level; in September they were about 2 million barrels below; in October, some 3 million below; and in November, about 4 million below. Flour buyers, faced with falling prices, have followed the common practice of restricting purchases on a falling market; and millers have apparently restricted their purchases of wheat accordingly.

Canadian visible supplies continued relatively high in August, since the carryover had been abnormally large. The low point was reached later than usual in September because the crop was late; and by comparison with the two preceding years, visibles in late September and October ran low on account of the late crop and unfavorable harvesting weather. In late October and November, as huge quantities of wheat were marketed, visibles increased with great rapidity. It is of interest to observe that thus far in the year, despite a crop estimated larger than that of 1925 and 1926, visibles have not reached notably higher levels. Exports have moved out rapidly, and receipts from the interior were not so large as the large crop presumably would have permitted under normal weather conditions. In view of the size of the Canadian crop and the relatively small proportion of it moved from farms up to December 1, it is possible that Canadian visibles may reach a mid-winter level comparable to the record level of 1923–24, when early in January the figure exceeded 140 million bushels.

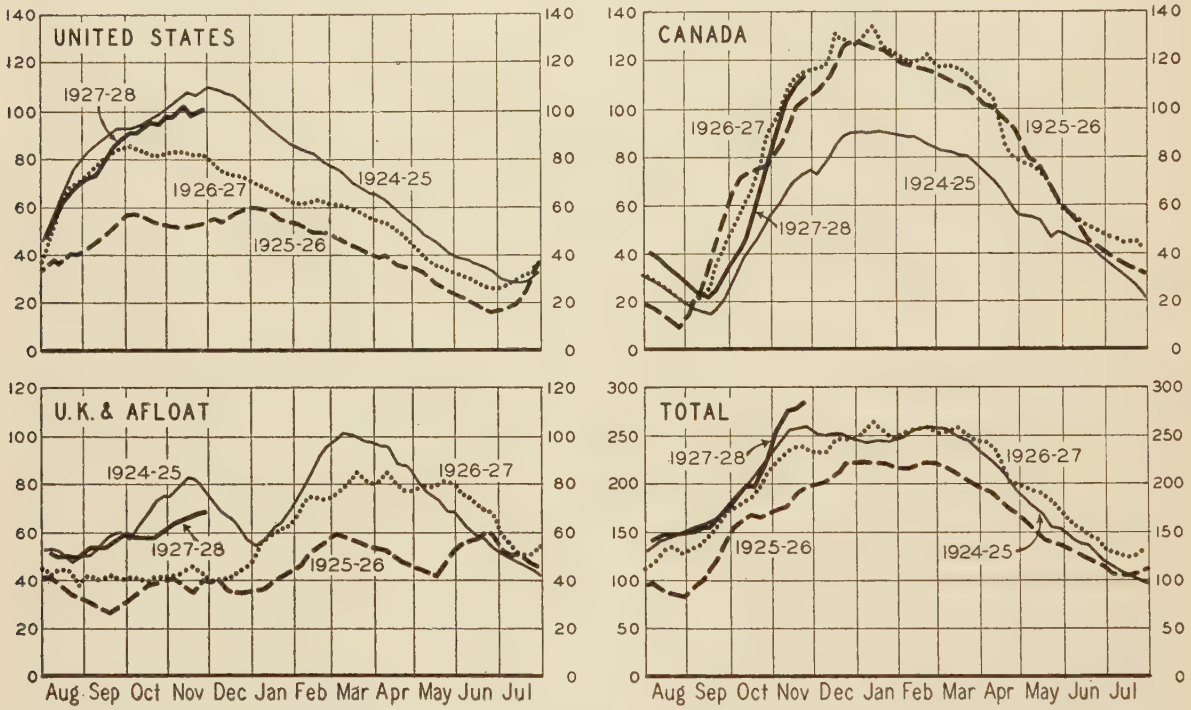
Visibles afloat and in ports of the United Kingdom ran high throughout August and September, especially by contrast with 1926, when much less wheat was moving from the Southern Hemisphere, and the situation in ocean freight rates was beginning (at least after mid-September) to restrict ship-

[1] See Appendix Table VI.

ments. Much higher figures in October and November this year than last are explained by the restricted shipments of last year resulting from the ocean freight rate situation.[1] The figures for 1927 throughout the four months under review have run higher than in any year of the past six except 1924, when shipments in late October and early began to rise rapidly, the figures reached unprecedented heights, and increased further in the course of the month. The month of November apparently witnessed the largest accumulation of visible supplies since the war. The combined statement of world visibles on December 1, which includes other stocks than those shown in

CHART 2.—VISIBLE WHEAT SUPPLIES IN THE UNITED STATES, CANADA, AND UNITED KINGDOM PORTS AND AFLOAT TO EUROPE, WEEKLY FROM AUGUST 1924*

(Million bushels)



* Data from *Price Current-Grain Reporter* and *Canadian Grain Statistics.*

November reached record heights for the season, on account of a marked shortage of supplies in Europe.[2] Stocks in ports of the United Kingdom have been fully double the size of stocks last year.[3]

Total visible supplies throughout August–November have been as large as in any of the past five years.[4] Toward the beginning of November, indeed, as Canadian stocks Chart 2, gave a figure of 347 million bushels in 1927, as compared with 326 million in 1924, when stocks were at their previous high level.[5] This is due primarily to the huge crop in North America. In other post-war years, while either the United States or Canada has had a larger crop, the combined output has not been so large; and the North American visible of course constitutes by far the largest proportion of world visible supplies in the autumn months.

In continental Europe as well, stocks of both imported and domestic wheat are said to be large.

[1] See WHEAT STUDIES, III, 154 f.

[2] See Chart 3, p. 116.

[3] See Appendix Table V.

[4] See Appendix Table V.

[5] Cf. Chart 6 in WHEAT STUDIES, III, 106, which shows the course of visibles in 1923–24.

With visible supplies so large, purchasers of wheat and flour, the world over, have felt in a comfortable position. Although liberal purchases have been made, there has been no rush to accumulate supplies. Business has been described as dull; but it has apparently been dull not in the sense that trade or consumption has been of small volume, but merely in the sense that purchasers have had no incentive to provide their requirements far in advance. A similar situation prevailed in 1923–24.

III. INTERNATIONAL TRADE, AUGUST–NOVEMBER

The volume of international trade in wheat and flour during the first third of the crop year was nearly of record size. Total shipments for the first 17 weeks, according to Broomhall's data summarized in Table 5,

TABLE 5.—INTERNATIONAL WHEAT AND FLOUR SHIPMENTS (BROMHALL), AUGUST–NOVEMBER, 1921–27*

(Million bushels)

Aug.–Nov.	To Europe				To ex-Europe	Grand total
	To U. K.	To Continent	To orders	Total		
1921	56.0	97.5	31.1	184.6	32.8	217.4
1922	55.9	112.3	21.0	189.2	29.6	218.8
1923	59.2	97.6	20.7	177.5	44.4	221.9
1924	66.5	114.0	47.8	228.3	26.7	255.0
1925	50.0	94.4	22.3	166.7	40.8	207.5
1926	54.2	117.2	24.9	196.3	36.5	232.8
1927	60.1	130.0	30.7	220.9	31.1	252.0

* Shipments are for 17 weeks, from Broomhall's *Corn Trade News*.

reached 252 million bushels, only 3 million bushels below the previous record for the period established in 1924. Shipments data understate the movement; for some wheat moving by rail and by river, especially from the Danube countries and Russia, is not recorded in full.[1] By contrast with 1926, trade was heavy this year largely because no such restricting influence as abnormally high ocean freight rates were operating, but also because European harvests were even later this year than last and the larger proportions of damp grain created a greater need for dry wheat. It is scarcely to be supposed that August–November trade this year will prove to have constituted so small a proportion of the year's total as was the case in 1926–27, when only 28.6 per cent of the year's shipments had been exported in the first third of the year. Ordinarily the movement of the first four months constitutes 32–35 per cent of the total.[2] By contrast with earlier years the heavy movement of 1927 appears less noteworthy if allowance is made for normal growth of international trade.

The course of trade, as shown with comparisons for earlier years in Chart 3 (p. 116), has presented few peculiarities; trade in the three preceding years presented more noteworthy features. September shipments (Broomhall's data) were perhaps larger than might have been expected in view of the sizable inward carryover in Europe; but the late and wet harvest necessitated heavy imports. American journals have characterized export demand as quiet practically throughout the period, and European journals have frequently commented upon the dullness of trade in import markets. The shipments data indicate, however, that trading has been of large volume, if quietly conducted. In November, purchasing appears to have been more active than in earlier weeks.

DISTRIBUTION OF IMPORTS

An altogether satisfactory insight into the distribution of imports cannot be obtained. Statistics of net imports of European countries for November are not yet available, nor of ex-European countries other than Japan and the four North African countries for any month. Export data, either official or Broomhall's, are unsatisfactory because of the large quantities of wheat and flour recorded as shipped to orders rather than to countries of destination. Nevertheless certain significant comparisons are possible.

As appears from Table 5, the August–November shipments to Europe were larger

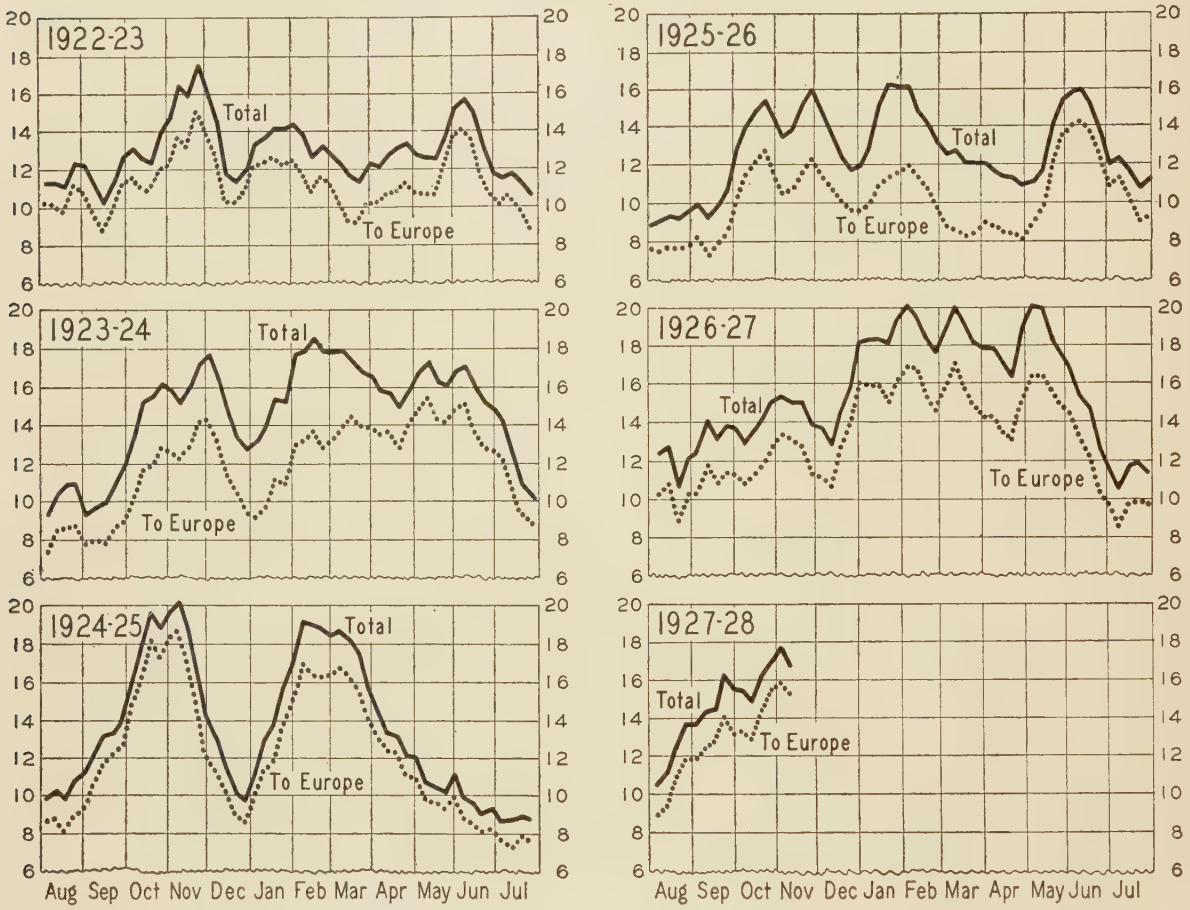
[1] Net exports from Hungary alone in August–October 1927 were 8.8 million bushels; but Broomhall's figures for Russian and Danube shipments combined for the period August–November were only 6.7 million. See Table 6 and Appendix Table VII.

[2] The year 1923–24 was an exception; but September shipments had been very small.

than in any of the past seven years except 1924, when crops were much smaller, and only 7 million bushels below the record figure then established. In general the late and wet harvest and normal growth of trade explain the high figure. Shipments of 31 million bushels to ex-Europe, on the other hand, were relatively small, especially if normal growth is considered. According to Broomhall's data,[1] the smaller takings in 1927 than in 1926 were due chiefly to smaller shipments to China and Japan and to Central America. But Egypt, North and South Africa, Chile, and New Zealand as well have apparently imported slightly less wheat and flour this year than last. Net import data confirm reductions in the imports of Japan, and also of Egypt, where the wheat crop is the largest in post-war years.[2] Brazil has taken considerably more, probably because better wheat was available from Argentina; and Peru, Syria, and India have taken slightly more. The decrease in shipments to China and Japan

CHART 3.—INTERNATIONAL SHIPMENTS OF WHEAT AND FLOUR, WEEKLY FROM AUGUST 1922*

(Million bushels: 3-week moving average)



* Broomhall's data, from the *Corn Trade News*.

[1] Broomhall reports shipments to ex-European destinations for the first 17 weeks of 1926–27 and 1927–28 as follows, in thousand bushels:

Destination	1926–27	1927–28
Central America[a]	12,424	11,184
China and Japan	11,896	6,600
Brazil	7,408	8,520
Egypt	2,888	2,856
North and South Africa	1,720	1,544
Chile	64	56
India	...	56
Syria	32	152
Peru	...	112
New Zealand	96	...

[a] Includes also Venezuela, West Indies, Dutch East Indies, etc.

[2] See Appendix Tables I and VII; cf. Appendix Table XXI in WHEAT STUDIES, IV, 55.

has probably been due to the larger crops of wheat and rice in the Orient. Tunis, a net exporter in the early months of 1926–27, has been a net importer this year; and exports from Algeria have been smaller this year than last, despite a larger crop. Last year exportation was stimulated by the demands of importers who sought near-at-hand supplies to avoid the payment of high ocean freight rates.

Among the major importers of Europe, most countries have apparently imported more heavily during August–November this year than in 1926. British, Belgian, Scandinavian, and Dutch net imports during August–October showed appreciable increases, and these increases are confirmed by Broomhall's shipments data for August–November. Net imports of Germany were somewhat smaller this year than last, principally because larger stocks of import wheat this year had made heavy importation in August unnecessary; September and October net imports were larger this year than last. On account of liberal marketings by farmers, Italy had imported slightly less wheat this year than last through October, though Broomhall's data show larger shipments for August–November.[1] The situation in France is not accurately revealed by official monthly trade statistics, which show a large increase in net imports this year—20.1 million bushels in August–October 1927 as against 7.4 million for the same period in 1926. Last year net import statistics understated the facts because importers were allowed partial refund of the duty and their imports often were not recorded until the wheat had passed into consumption and the duty was paid; and this year's figures, especially for August, presumably include some wheat which reached France several months before. Broomhall records direct shipments to France of 18.6 million bushels in August–November 1926 as against only 12.0 million for the same period of 1927; and these figures, showing a large decrease in French takings this year, probably represent the facts more closely than do the official data.[2]

[1] For any given period, of course, net imports to a European country could not be expected to coincide precisely with exports or shipments to that country.

[2] Broomhall's data on shipments of wheat and flour, in million bushels, by countries of destination are as follows for August–November in the past two years. These data do not disclose the full quantities of wheat carried to the designated destinations, for each country presumably secures some of the wheat and flour recorded as shipped to orders.

Country	1926	1927	Country	1926	1927
France	18.6	12.0	Italy	18.2	20.3
Belgium ...	17.0	24.6	Greece[a]	5.3	5.0
Holland ...	23.2	30.4	Scandinavia	6.9	7.2
Germany[b] ..	21.3	24.6	Austria[c] ...	5.7	4.8

[a] Includes Turkey.
[b] Includes also Poland and Czecho-Slovakia.
[c] Includes Malta.

Sources of Exports

North America, as usual, furnished the bulk of the world's exports during August–November. According to Broomhall's shipments data shown in Table 6 (p. 118), this year's shipments exceeded those of 1926 by 12 million bushels. Canadian new-crop wheat naturally has moved slightly less freely this year than last on account of the later crop. Net exports of 31.6 million bushels in August and September were 6.8 million bushels larger than last year's because the large carryover of old-crop wheat permitted a relatively heavy movement. Net exports in October, when relatively small quantities of wheat were threshed, were over 11 million bushels smaller this year than last. In November, however, the movement became very rapid; 58 million bushels were exported, as against 50 million last year.

United States net exports of 126 million bushels have been exceeded only in 1924 and 1921, and ran about 21 million bushels higher than in 1926 for the August–November period. The export movement began more slowly this year. July and August net exports totaled only 39 million bushels as against 54 million in the same months of 1926. Last year European countries hastened to obtain winter wheat of excellent quality from the southwestern states, while little old-crop Canadian wheat was available; but this year more old-crop Canadian wheat was available and the southwestern states had smaller crops of poorer quality. In September and October this year net exports from the United States were large—74 million bushels for the two months as against 52 million in 1926. This was principally due to an exceptionally heavy movement from the Pacific Coast following the harvest of a huge crop and heavy marketings of damp wheat. It largely escaped

the attention of eastern traders. During August–November exports of wheat and flour from Pacific Coast customs districts totaled 43 million bushels, a third of the United States total, as against 29 million in 1926. In September and October alone exports from this region reached 28 million bushels this year, some 12 million bushels above those of a year ago.[1] Consequently exports from areas east of the Rockies have not been so noteworthy this year as appears at first glance from the United States totals. and a smaller movement from Australia, since the Argentine crop is apparently large, the Australian small.

India has exported only a little more wheat this year than last. The reduction in Russian and Danube shipments is more noteworthy. As we have previously had occasion to point out, Broomhall's data understate the export movement from these areas by considerable amounts.[3] Dependable information on Russian exports this year is not available; but since Broomhall's

TABLE 6.—INTERNATIONAL SHIPMENTS AND NET EXPORTS OF WHEAT AND FLOUR FROM PRINCIPAL EXPORT AREAS, AUGUST–NOVEMBER, 1921–27*

(Million bushels)

Aug.–Nov.	International shipments (Broomhall)								Net exports from	
	Total	North America	Argentina	Australia	Russia	Danube	India	Other	United States	Canada
1921	217.4	178.4	6.9	29.3	2.3		.2	.3	149.0	71.8
1922	218.8	183.6	24.7	6.9	2.6		1.0	....	106.2	128.8
1923	221.9	151.2	31.8	14.7	8.9	4.2	4.8	6.3	64.3	126.2
1924	255.0	201.4	26.7	12.3	.3	1.1	12.4	.8	149.0	76.0
1925	207.5	145.3	18.7	10.4	11.2[a]	2.4[a]	1.4	17.7	35.2	123.9
1926	232.8	183.3	7.0	5.7	15.6	5.2	2.4	13.6	104.8	109.3
1927	252.0	195.0	21.1	13.6	3.9	2.8	3.5	12.2	126.1	112.9

* Shipments are figures for 17 weeks, from Broomhall's *Corn Trade News*. Net exports are official data.

[a] Combined shipments from Russia, Danube, and Black Sea were reported as 14.0 million bushels which differs slightly from the sum of items here given.

Shipments and net exports[2] from the Southern Hemisphere were much larger during August–November this year than last, when Australia's exports out of the small crop of 1925 had been mostly completed by August, and the Argentine exportable surplus of poor-quality wheat was not in demand. The movement from Australia and Argentina this year has apparently been of normal size for the season, size of crops considered. Next year the August–November period may witness a similar or larger movement from Argentina shipments during August–November have totaled only 3.9 million bushels as against 15.6 million last year and 11.2 million in 1925, there can be little doubt that the movement has been the smallest since 1924, perhaps smaller than in 1923. Broomhall reported no export movement until late September this year. Presumably ample stocks of wheat existed in Russia at the opening of the crop year, and the crop of 1927 seems not to have been distinctly small. Yet the peasants have apparently parted with their grain reluctantly, probably because prices of manufactured articles have been disproportionately high.

Of the Danube countries, Jugo-Slavia has apparently had little wheat to export on account of the short crop. For Roumania and Bulgaria data are not available; but both of these countries have probably exported more than Broomhall's figures suggest—perhaps as much as last year, though the facts are not yet known. Hungary, out of a crop slightly larger than last year's and of far better quality, exported 8.8 million bushels in August–October as against

[1] Official data on exports of wheat and flour from Pacific Coast customs districts during August–November for the past four years are as follows, in million bushels:

1924	17.6	1926	28.6
1925	11.6	1927	42.6

[2] For the Southern Hemisphere, Broomhall's shipments data always coincide closely with official net export data. This is not true of North American figures; Broomhall's annual data usually fall somewhat below the official, for the first half of the year far below because large quantities of Canadian wheat officially recorded as exports have passed only as far as United States lake ports.

[3] See above, p. 115, and WHEAT STUDIES, III, 158 f.

10.8 million in 1926. Exports from the Danube countries in the fall of last year were stimulated by the situation in ocean freight rates. This year, with no such stimulus present and considerably smaller crops in Roumania and Jugo-Slavia, exports might well be expected to prove smaller. On the other hand, the better quality of Danube wheat this year may result in increasing exports later in the season. The Hungarian press has already reported increased milling activity and flour exportation.

IV. WHEAT PRICE MOVEMENTS

The Level of Wheat Prices

Cash prices of wheat on the world's leading markets during August–November have on the whole reached the lowest level for a similar period since the war, 1923 excepted. Comparisons of average and fairly representative cash prices for the past five years, including 1923–24, the year of lowest postwar price, are given in Chart 4 (p. 120). Weighted average prices in United States markets in October approached the low level of 1923 rather closely. The series of British parcels prices may be regarded as the most reliable indicator of world price movements, since it includes all the significant types and grades of wheat moving from the major exporting countries in international trade, and is not so much affected as Canadian and American prices by local developments. During August 1924 and part of October 1925, British parcels prices were lower than this year; but these were the only noteworthy occasions when such was the case during August–November in the past four years. No. 3 Northern Manitoba, however, was cheaper not only in these months, but also in August and early September 1926. This year the late harvest in Canada extended a period, beginning perhaps as early as January 1927, when sound Canadian wheat was at a premium in world markets. The new crop contains comparatively little wheat grading No. 3 Northern or better; and it is possible, unless the Argentine crop proves to be of unusually good quality, that even higher premiums for Canadian wheat of the higher grades will prevail in 1927–28 than prevailed in the latter part of 1926–27. It is significant that No. 3 Northern at Winnipeg throughout August–November this year has not sold so far below the prices ruling in the same months of earlier years as has been true of weighted prices in United States markets or of British parcels prices.

Certain further comparisons are of interest. Last year, at the end of October, British parcels prices rose to over $1.80 per bushel, while at the same time in 1927 the price was less than $1.50—a difference of more than 30 cents per bushel. Similar comparisons for No. 3 Northern at Winnipeg and for weighted prices in United States markets show far smaller differences, some 15 cents per bushel in Winnipeg, and about 20 cents in the United States. High ocean freight rates at the end of October last year raised British prices relative to American and Canadian; and the more noteworthy shortage of the higher grades of Canadian wheat this year than last has resulted in a relatively higher current price for Canadian wheat than for American. These relationships, and the fact that (because the United States was on a domestic basis in 1925–26) American prices in October 1925 were not, like Canadian and British, lower than in October 1927, well illustrate the fact that wheat prices in different large markets by no means remain in identical relationships from year to year. The broad movements are similar, but special circumstances operate to create considerable and significant aberrations.

As judged by British parcels and American prices, the August–November level of world wheat prices has been relatively lower than in 1926, though Canadian prices show less marked differences. French, British, Italian, and German prices of domestic wheats[1] have been much lower this year than last. In France, average October prices were 34 cents a bushel lower in 1927 than in 1926; and in Italy the difference was 44 cents. Several factors account for the lower level this year. The international position is somewhat easier,[2] but in some part the lower level of 1927 may reflect the abnor-

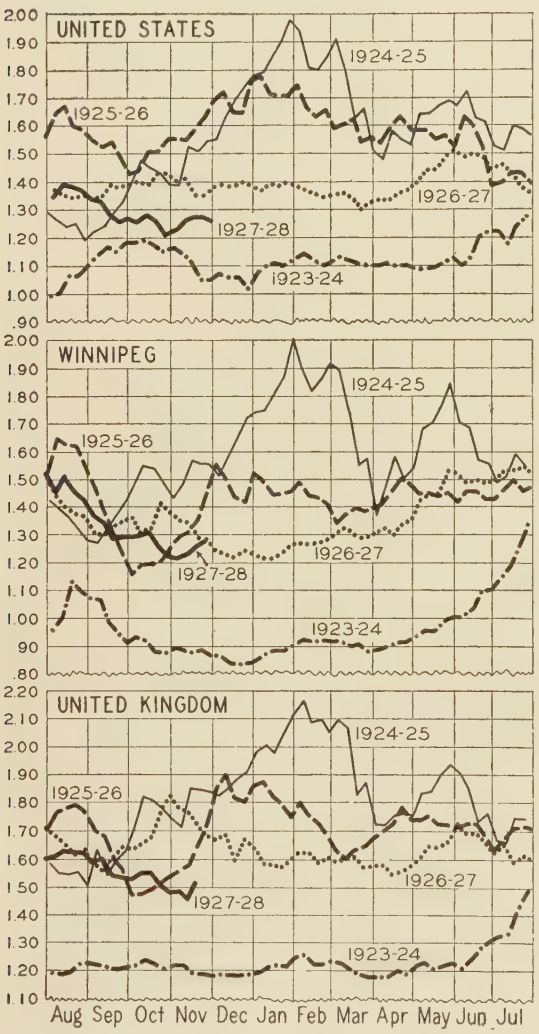
[1] See Appendix Table X.

[2] See below, pp. 122 f.

mal situation in ocean freights last year, and in part (especially in France and Italy) more rapid marketing by farmers this year. Moreover, other things being equal, relatively lower prices this year than last would be expected for British, French, and German wheats, which are of poorer quality this year. In Italy, however, quality is excellent this year, and lower prices cannot be attributed to this factor.

CHART 4.—WEEKLY AVERAGE CASH PRICES OF ALL CLASSES AND GRADES OF WHEAT IN FIVE PRINCIPAL UNITED STATES MARKETS, OF NO. 3 MANITOBA NORTHERN IN WINNIPEG, AND OF SALES OF PARCELS OF ALL CLASSES OF WHEAT IN THE UNITED KINGDOM, FROM AUGUST 1923*

(U.S. dollars per bushel)



* Data from *Crops and Markets, Canadian Grain Statistics,* and *London Grain, Seed and Oil Reporter.* United States prices are weekly weighted averages from six markets since the first week in January 1927.

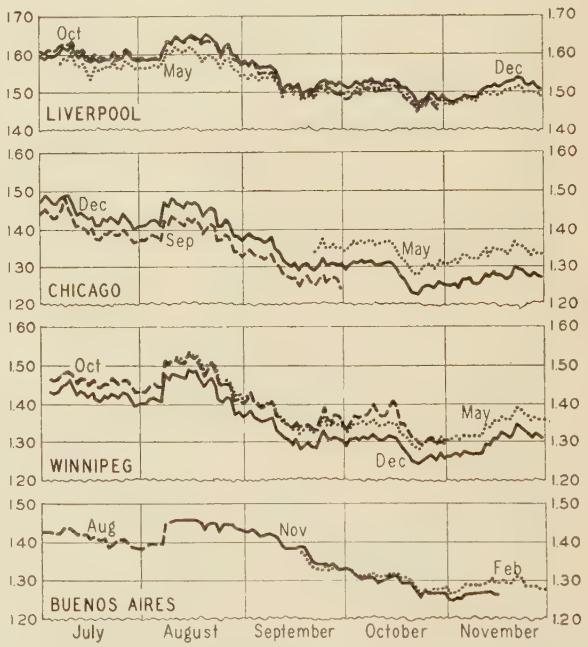
THE GENERAL COURSE OF PRICES

The general course of wheat prices has tended downward during most of the period under review, chiefly under the influence of crop developments in Canada. Comparisons of futures prices in the leading markets of the world are shown in Chart 5, in greater detail than is given by the average weekly cash prices shown in Chart 4. Both futures and cash prices in the several markets show movements more striking for their similarities than for their differences. There was a sharp rise in all markets on August 8; a noteworthy decline, interrupted by periods of comparative stability, from August 8 to October 24 or 25; and a slow recovery during the last week of October and most of November.

The sharp rise in prices on August 8/9, of 7 cents in Winnipeg and 4½ cents in Liver-

CHART 5.—DAILY CLOSING PRICES OF PRINCIPAL WHEAT FUTURES IN FOUR LEADING MARKETS, JULY–NOVEMBER 1927*

(U.S. dollars per bushel)



* Data from *Chicago Journal of Commerce* and *Daily Trade Bulletin,* Chicago.

pool, followed the frost in Canada on the night of August 7. For a week or more thereafter the markets were nervous. In response on the one hand to conflicting reports on the extent of frost damage, the progress of rust infestation, and wet harvesting weather in Europe, and on the other hand to profit-taking, prices moved erratically but did not depart far from the high level established on August 8.

The decline began on August 18, on reports of good weather in Canada and private estimates of a large crop despite the frost. Subsequently until mid-September, every day of fair weather in Canada occasioned further recessions, despite frequent reports of unfavorably wet harvesting weather in Europe, which had more effect in Liverpool than in Chicago or Winnipeg. An especially sharp decline occurred on September 10, following the United States official estimate of spring-wheat production. The report, though it showed an increase of only 10 million bushels over the August estimate, was regarded as bearish because traders had been led, by private estimates and reports of rust damage, to expect a decrease. A second notable decline occurred on September 13, following the Canadian official estimate. The decline was checked by unfavorable weather in Canada and Europe and by reports of drought in the Southern Hemisphere. Subsequently until mid-October fluctuations were small; but eventually good harvesting weather in Canada and exceptionally heavy receipts in that country and the United States, together with favorable prospects in the Southern Hemisphere, combined to force a further decline, most marked during the week ending October 22.

On October 24 futures prices reached their lowest level for the August–November period. The ensuing upturn was less spectacular than the preceding decline. Crop developments exerted less influence, though conflicting reports from Argentina on the whole made for firmness, and the official Canadian estimate (issued November 11) was construed as bullish. Throughout August–November speculative interest was small, at least in the United States, as is natural on a falling market.[1] American speculators are said to have transferred their interest largely to corn and to stocks.

The fundamental cause of firmness after October 24 was probably a change in sentiment natural enough in view of the extent of the August–October decline, which amounted to over 25 cents a bushel at Chicago and Winnipeg. With the lower level of prices and reasonable assurance that no further marked changes in crop prospects might be expected, purchasers of cash grain were encouraged to increase their activities. The relaxation of hedging pressure was probably influential also.

The relations of near and distant futures in the different markets showed few peculiarities. With ample wheat available for delivery on contracts, the September future closed at a discount in Chicago, and the October futures in Liverpool and Winnipeg closed quietly. During late September and the first half of October, however, the October future at Winnipeg had commanded a considerable premium over the December. This resulted from unfavorable harvesting weather in Canada, which gave rise to fears that sufficient wheat might not become available in October to permit deliveries on contracts.

United States Cash Prices

Certain features of the movement of United States cash wheat prices during the past five months are of interest. Weekly averages for leading varieties of wheat are shown in Chart 6 (p. 122), with comparisons for preceding years. Winter-wheat prices (No. 2 Hard and No. 2 Red Winter) declined in June and July, with the advent of harvest, somewhat more rapidly than futures prices, and much more than spring wheat prices (No. 1 Dark Northern and No. 2 Amber Durum), which were supported by the possibility of extensive rust damage and the general uncertainty in respect to spring-wheat prospects in North America. Spring-wheat prices, particularly of No. 2 Amber Durum, naturally responded to the

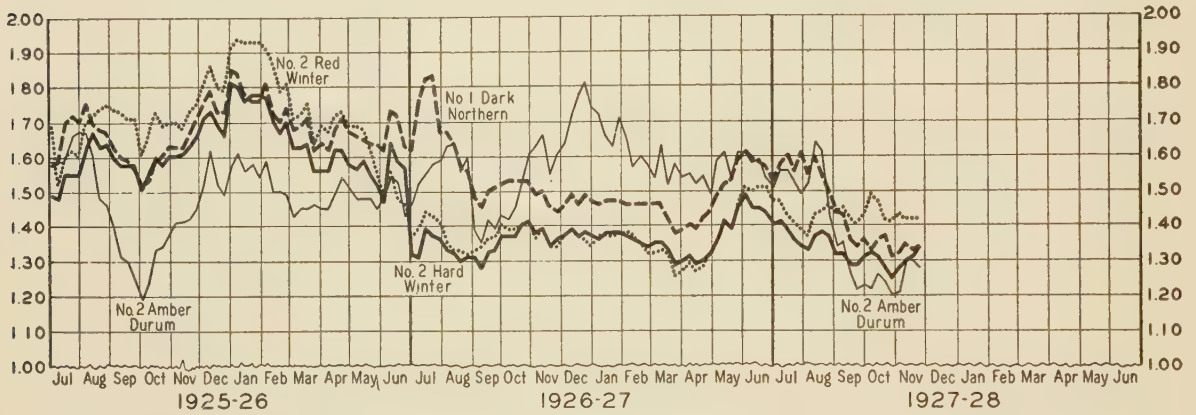
[1] The average daily volume of future trading in all United States markets in the four months of the period has run as follows in the past four years, in million bushels:

	August	September	October	November
1924.....	50	43	61	61
1925.....	60	59	60	65
1926.....	47	46	44	53
1927.....	42	37	37	35

frost in Canada on August 7 more sharply than did winter-wheat prices. With the advent of harvest in August and September, prices of the spring wheat showed their usual seasonal decline. Restricted buying by mills has this year contributed to the declining prices of both spring and winter situation last year. Hard spring wheat has not maintained last year's premium over the winter wheats because of the larger crop. Soft winter wheat, short in supply this year, began to command a premium over hard winter as early as June, and there has been a tendency for the premium to

CHART 6.—WEEKLY AVERAGE CASH PRICES OF TYPICAL WHEATS IN UNITED STATES MARKETS, FROM JULY 1925*

(U.S. dollars per bushel)



* No. 2 Red Winter at St. Louis, No. 2 Hard Winter at Kansas City, No. 1 Dark Northern Spring, and No. 2 Amber Durum at Minneapolis. Data from *Crops and Markets*.

wheats. By the end of September the relationship of prices for the several types of wheat was probably established at approximately the position for the year as a whole. The general relationships which prevailed in 1925–26 seem likely to prevail in 1927–28, but sharp differences appear between this year and last.

This year durum wheat, as the result of a huge crop, promises to sell at a discount under hard spring or hard or soft winter, much as has been the case since late September, and sharply in contrast with the increase. Wheat of high protein content has secured far higher premiums this year than last, when both the winter- and the spring-wheat crops contained an unusual proportion of grain of high protein content. At Kansas City at the end of October 1927, No. 2 Hard Winter with 13 per cent protein content was selling for 8½ cents more per bushel than No. 2 Hard with 12 per cent protein, whereas last year the price differential was only one cent; and at Minneapolis a similar situation prevailed with respect to hard red spring wheat.

V. THE INTERNATIONAL POSITION AND OUTLOOK

Having reviewed the salient features of the first few months of the current crop year, we are now ready to consider the statistical position for the year as a whole. An evaluation of the international position is essential in forming a judgment respecting the outlook for international trade, world prices, and carryovers for ensuing months and the crop year as a whole. Deficiencies in the statistical data on production, consumption, and trade necessarily render evaluation of the statistical position uncertain. It seems clear, however, that the position in 1927–28 may properly be described as fairly easy—not so easy as in 1923–24, but much easier than in 1924–25 or 1925–26. Comparisons with last year are especially difficult because the crop estimates now standing for both years cannot be unreservedly accepted; and in general similarities

between the two years are more noteworthy than differences.

The International Statistical Position

A rough indication of the statistical position in the past five years is provided by the following rounded figures, in million bushels, which show the wheat crops of European importing countries (all European countries except Russia, the Danube exporters, and Spain) in comparison with the crops of the major exporting countries (Canada, the United States, Argentina, and Australia). The 1926 figure for the major exporters is partially estimated to allow for an apparent underestimate of North American crops; but the 1926 figure for Europe is not adjusted for a probable underestimate of the French crop. The 1927 figures are the official estimates available to us on December 20.

	1923	1924	1925	1926	1927
European importers ..	830	720	930	760	830
Major exporters	1,640	1,480	1,450	1,670	1,670

At first glance these data suggest a statistical position for 1927–28 quite as easy as that of 1923–24; but in the interval the world's requirements for consumption have increased, probably more rapidly in importing than in exporting countries—and little if any more wheat is this year available in exporting countries to supply larger import requirements than in 1923–24. The data indicate with sufficient clarity that the margin between exportable surpluses and importers' requirements is larger this year than in 1924–25 or 1925–26.

With respect to the relative positions in 1926–27 and 1927–28, the data given above are unsatisfactory. It may perhaps be said that the major exporters, especially in view of larger carryovers, have more wheat available for export this year than last; the situation is uncertain because official estimates of the Canadian crop appear likely to be downward, but perhaps below the truth if so revised, while the Southern Hemisphere crop estimates, if revised at all, may be revised upward. But it seems probable that Russia and the Danube countries will export less wheat this year than last; and on the whole the world's exportable supplies, while somewhat larger than last year, are not notably so. The needs of importing countries also differ little from those of last year. The wheat crops of European importing countries are probably not, as the official data suggest, 70 million bushels larger than in 1926–27, for the French crop was probably underestimated last year, and this year's crops in northwestern Europe appear to exaggerate the available supplies of millable wheat. On the other hand, larger initial carryovers this year than last, and larger crops of rye and potatoes, suggest that European importing countries would take, at equivalent prices, slightly less wheat in 1927–28 than in 1926–27, even with allowance for increase due to growth of population, increasing preference for wheat bread, and further economic recovery. Ex-European countries, notably China and Egypt, probably need somewhat smaller imports this year on account of larger crops.

On the whole it appears to us reasonable to suppose that the margin between exportable surpluses and importers' requirements in 1927–28 is slightly larger than in 1926–27. Moreover, the artificial tightness of the early months of 1926–27, due at first to low stocks in Europe and late crops, and thereafter to the advance in ocean freight rates, has not been present this year, even though the wheat crops were again late. But the contrast between the two years is by no means striking, and unpredictable revisions in crop estimates, increasing knowledge of the utilization of poor-quality wheat as the year progresses, or an exceptionally large or small crop in India may alter the position in either direction.

Practically all observers are agreed that the international position this year differs little from that of 1926–27, though calculations adduced to demonstrate the fact show differences of detail. The margin of exporters' surpluses over importers' purchases implied by Broomhall's latest calculations is of the same size as last year if his reported shipments for 1926–27 are subtracted from his estimate of available surplus for that year. The figure is 92 million bushels for both years. If his November estimates for this year and last are compared, the margin was much the larger last year—152 million bushels as against 92 million.

Last year, however, Broomhall in November greatly underestimated importers' purchases; this year his estimates, perhaps on account of the experience of 1926–27, are more adequate. The *London Grain, Seed and Oil Reporter* estimates the margin between supplies and requirements as 232 million bushels if carryovers into the year are included in available supplies, compared with a margin of 176 in 1926–27; or as 104 million bushels in 1927–28 and 96 million in 1926–27, if carryovers are not included in available supplies.

Probable Net Imports in 1927–28

Students of the wheat situation differ in their methods of estimating the volume of international trade in wheat and flour, but the differences are too detailed for consideration here. In our judgment the most satisfactory measure at present is net exports rather than shipments or net imports, largely because import statistics are notably deficient for ex-European countries and are otherwise misleading, while shipments data understate the facts.

The sum of net imports of importing countries for a given year can never be calculated; but even if it could, it would never equal the sum of the net exports of exporting countries.[1] Nevertheless, the wheat which is exported must pass to some destination, and forecasts of probable net imports are useful for indicating which countries appear to require more wheat, and which less, than in preceding years. Table 7 shows our estimates for the leading European importing countries, in comparison with the reported net imports of 1926–27 and the most recent forecasts of other observers of the situation.

Net imports of Great Britain and the Irish Free State we estimate at 240 million bushels. Last year's heavy imports of 237 million bushels were used in some part to build up stocks depleted in 1925–26, and further increases of stocks seem improbable in 1927–28. But with lower import prices, comparative freedom from economic disturbances, and a domestic wheat crop containing an abnormally large proportion of unmillable grain, a slight increase seems more probable than a decrease.

Table 7.—Net Imports of Principal European Importing Countries in 1926–27, with Forecasts for 1927–28*

(Million bushels)

Country	Net imports 1926–27	Forecasts for 1927–28		
		Broomhall Nov. 29	U.S.D.A. Nov. 21	F.R.I. Dec. 20
British Isles	237.0	240.0	223–251	240
Italy	86.6	94.4	95–105	100
Germany	91.8	91.2	85–100	100
France	62.0	32.0	45–55	45
Belgium	39.5	40.8	40–42	40
Netherlands	28.4	25.6	27–29	29
Scandinavia	19.6	22.4	17–20	20
Switzerland	16.3	16.1	14–17	17
Austria	17.0	16.8	15–16	17
Czecho-Slovakia	20.1	16.8	15–18	19
Total	618.3	596.1	576–653	627

* Net import data are from official sources, in large part through International Institute of Agriculture; Broomhall's forecasts from the *Corn Trade News;* U.S. Department of Agriculture forecasts from *Foreign News on Wheat: World Wheat Crop and Market Prospects,* November 21, 1927. Figures are for crop years August–July, except U.S. Department of Agriculture estimates, which are for July–June. Broomhall's estimates are apparently for *shipments* to the destinations given.

The Italian crop is now estimated 25 million bushels smaller this year than last. The tariff and milling regulations remain unchanged. Imports of about 110 million bushels would be required to maintain apparent domestic utilization (crop plus net imports) at the high levels of the past two years; and per capita wheat consumption is apparently increasing. But last year appreciation of the lira encouraged importation; and in 1925–26 the domestic crop was very large. In view of a large though unmeasured carryover of old wheat into the crop year 1927–28, the probability of stable exchanges throughout 1927–28, and the likelihood that any possible bias in crop estimating would have resulted in figures too high for 1925 and 1926 rather than for 1927,[2] we are disposed to estimate Italian net imports at 100 million bushels. Average annual domestic utilization for the past five years, which may be regarded as a fair indicator of actual average consumption, has

[1] The principal reasons are the varying intervals between entry of export and entry of imports, and errors in statistics.

[2] The reliability of Italian crop estimates cannot be tested; but it is pertinent to observe that the reduction of nearly 20 million bushels in the Italian estimate for 1927 occurred long after harvest, and apparently at a time when native wheat was not receiving full protection from the tariff.

been about 290 million bushels. If one assumes no increase in stocks during the year, allows roughly for apparent growth in consumption, and accepts the official crop estimate, imports of 100 million bushels would provide Italy with a normal supply of wheat.

As most observers have noted,[1] the French situation is difficult to evaluate. Crop estimates range from 284 to 338 million bushels,[2] with the official figure the lowest; and the crop contains an unknown quantity of unmillable grain. Official statistics for August–October 1927 throw little light on probable future net imports or on the French supply situation for 1927–28, since some unknown fraction of the reported August–October imports may have reached France weeks or months before they were recorded in the net import statistics. French millers may require to import considerable quantities of suitable milling wheat, but they perhaps anticipated requirements to a considerable extent in view of the agitation for an increase of the tariff. On September 2 the tariff was raised from 18.2 francs per quintal to 25 francs, and on November 18, to 35 francs, equivalent to about 37 cents per bushel. The high duty will tend to restrict imports; on the other hand, reduction of the percentage of wheat substitutes to be mixed with wheat flour (from 10 to 6 per cent) may act to increase consumption slightly. The carryover of old-crop wheat was apparently large. Furthermore, the late harvest of the 1927 crop necessitated heavier imports in August–October than would otherwise have occurred. If next year's crop is harvested under normal conditions, the present crop year may be effectively shortened. With such allowances for the complex situation as we are able to make, we estimate the net imports of France at 45 million bushels.

German net imports of 92 million bushels in 1926–27 were the largest in post-war years. Wheat consumption is perhaps increasing more rapidly in this country than elsewhere in Europe. The German wheat crop is estimated some 18 million bushels larger this year than last; the rye crop is apparently somewhat larger; the potato crop is much larger. But considerable amounts of wheat and rye were damaged at harvest, and available supplies of breadstuffs are perhaps only slightly larger than in 1926–27. Native rye has been selling only 10–15 cents per bushel below native wheat; this we interpret as indicating that substitution of rye for wheat will not be a material factor in reducing wheat imports. Lower wheat prices than in 1926–27 may further stimulate wheat consumption. The stocks of import wheat, however, were large at the opening of the crop year, and seem unlikely to show an increase at the end of 1926–27. We anticipate that German net imports may reach the record figure of 100 million bushels this year.

The smaller European net importing countries listed in Table 7 have imported much the same quantities of wheat in each of the past five years, and large variations this year are not to be expected. Slightly larger crops both of wheat and wheat substitutes in most countries may be offset by lower import prices of wheat and normal growth of trade. Among the European importing countries not listed in Table 7, there is none which appears likely to import appreciably more wheat this year than last. Poland, with a larger crop of both wheat and rye and a recent prohibition of imports, will presumably take less; Greece also has a larger wheat crop this year than last. For Europe as a whole it now seems probable that net imports of 1927–28 will fall slightly below those of 1926–27, but only slightly. Among the ex-European importers, it seems probable that smaller imports to the Orient and Egypt will more than offset larger imports to Brazil.

We regard our estimates as liberal in the aggregate, but even so, we are disposed to expect that importing countries will take slightly less rather than slightly more in 1927–28 than they took in 1926–27. With the world's available export surpluses apparently slightly larger this year than last, and the requirements of importers slightly smaller, the international position appears slightly easier.

Probable Net Exports in 1927–28

Probable net exports of the major exporting countries may be estimated directly

[1] See especially the U.S. Department of Agriculture's *Foreign News on Wheat*, December 12, 1927, pp. 4 f.

[2] Estimate of the *Moniteur Agricole* of Bordeaux.

from disposition data.[1] Our estimates, in comparison with those of the United States Department of Agriculture, and reported net exports in 1926–27, appear in Table 8.[2]

TABLE 8.—NET EXPORTS OF PRINCIPAL EXPORTING COUNTRIES IN 1926–27, WITH FORECASTS FOR 1927–28*

(Million bushels)

Exporting area	Net exports 1926–27	Forecasts for 1927–28	
		U.S.D.A. Nov. 21	F.R.I. Dec. 20
United States	199	220–245	225
Canada	292	300–330	317
Argentina	143	120–170	151
Australia	103	55–80	74
Russia	49	5–30	20
Danube basin[a]	46[b]	22–41	30
India	14	5–10	8
Others	2[c]	3–16[d]	...
Total	848[b]	730–922	825

* Net export data are from official sources and International Institute of Agriculture; U.S. Department of Agriculture forecasts from *Foreign News on Wheat: World Wheat Crop and Market Prospects*, November 21, 1927. Figures are for crop year August–July, except U.S. Department of Agriculture estimates which are for the year July–June. Totals are for items listed in table, and are not strictly comparable with each other.

[a] Roumania, Bulgaria, Hungary, and Jugo-Slavia. For 1927–28 Jugo-Slavia reported as possibly on an import basis, and not included in the forecasts made by the U.S. Department of Agriculture.

[b] Partially estimated.

[c] Includes Morocco, Tunis, and Chile.

[d] Algeria only.

In the United States, human consumption of wheat may be estimated at 502 million bushels, 10 million bushels higher than last year principally because more wheat will be required per barrel of flour.[3] Seed requirements will probably reach 90 million bushels in view of the large acreage sown to winter wheat in the fall of 1927. Stocks on farms, in country mills and elevators, and visible seem likely to increase, though stocks held by city mills may decrease since the crop is inferior in quality to that of 1926. Total stocks at the end of the year may reach 155 million bushels, as against 138 last year. The sum of the foregoing items of disposition, 747 million bushels, subtracted from the available supplies of 1,010 million bushels, leaves a residue of 263 million bushels for export and feed and waste. The quantity of wheat fed and wasted, is likely to be larger this year than last on account of poorer quality, particularly in the Pacific Northwest; but in the absence of direct estimates for past years, the probable disappearance is difficult to calculate. We employ a figure of 38 million bushels, some 20 million higher than the figure for last year, which was low because the crop was apparently underestimated. The use of this figure of 38 million bushels for 1927–28 involves the assumption that the wheat crop will prove to have been underestimated for the third consecutive year, and does not imply that only 38 million bushels of wheat will in fact be fed and wasted.

With supplies available for export and feed and waste of 263 million bushels, we thus anticipate net exports of about 225 million. This figure is calculated on a July–June crop year; but, unless the harvest of the 1928 crop is as early as that of 1926, an August–July figure would not be materially different. We regard our estimates for human consumption, seed requirements, and carryover as more reliable than the estimates for crop, feed and waste, and net exports.

For Canada, the apparent underestimates of crops in recent years and uncertainty respecting the estimate for 1927 render forecasts of probable net exports difficult. The progress of threshing in Canada after the last official crop estimate was issued in October suggests that the final estimate may be reduced; but it is in some degree probable that a reduction will result in a figure below the truth, and we are tentatively disposed to accept the October official estimate. Seed requirements and grain unmerchantable and lost in cleaning are likely to be a little larger this year than last, and consumption requirements and wheat fed on farms no smaller. The carryover appears more likely to decrease slightly than to increase, since so great delay in seeding, which apparently encouraged the Pool to build up stocks toward the end of 1926–27, is unlikely to occur next year. Consequently we estimate probable

[1] See Appendix Table XI.

[2] This year Broomhall has not estimated probable shipments.

[3] For our method of estimating flour and wheat consumption in the United States, see "Statistics of American Wheat Milling and Flour Disposition since 1879," WHEAT STUDIES, December 1927, IV, No. 2.

net exports at about 317 million bushels, the residue when probable consumption and outward carryover are subtracted from the supplies apparently available.

Argentine net exports promise to reach the high figure of 151 million bushels. Seed requirements and flour consumption bid fair to prove slightly larger this year than last. Wheat fed and wasted may be less because there is apparently no such amount of poor-quality wheat as existed in the first half of 1926–27 following the crop of 1925–26. Stocks may show a small increase, but only a small one, because Argentine stocks apparently vary but little from year to year. These items of disposition come to 150 million bushels; with a crop of 240 million bushels and stocks on August 1, 1927, of some 61 million, net exports of 151 million seem probable. But larger net exports are possible if the crop estimate is revised upward, as one may perhaps anticipate in view of reported favorable harvesting weather.

Accepting the latest official estimate of Australian wheat production, and allowing for a small decrease in stocks from the high figure of August 1, 1927, we estimate Australian net exports at 74 million bushels. Our estimate may be exceeded if, as some observers suppose, the crop is larger than the official estimate indicates; but on the whole, in view of deficient rainfall during the growing season, we are disposed to assume that our estimate of net exports is liberal. Domestic utilization of wheat will probably be but slightly if any larger this year than last.

In the aggregate, net exports from the four major exporting countries thus promise to reach about 767 million bushels as compared with 737 million actually reported in 1926–27. This quantity would be the largest ever shipped from these countries regarded as a group. But smaller exports are in prospect from Russia and the Danube countries. The Russian situation is uncertain; but since the 1927 wheat crop is apparently smaller than the crop of 1926, while collections of grain and exports of wheat have been smaller this year than last and credits facilitating exports are reported to have been less easy to obtain, we estimate Russian net exports in 1927–28 at 20 million bushels. On account of smaller crops in Jugo-Slavia and Roumania and the reported unwillingness of producers to sell wheat at the prices which have thus far prevailed, net exports from the Danube countries will apparently not exceed 30 million bushels this year, as compared with 46 million in 1926–27. India will probably export only about 8 million bushels unless the crop to be harvested in March–May proves larger than now appears likely. Other exporters will presumably contribute negligible quantities.

In the aggregate, net exports during August–July 1927–28 thus seem likely to be about 825 million bushels, about 25 million smaller than last year and much the same as in 1923–24. North America bids fair to provide two-thirds of the total, the largest fraction in six years; and Argentina and North America together will probably furnish five-sixths of the total. Our estimate, of course, must be regarded as the middle of a range, and further information on North American crops in particular may necessitate alterations in both the total and the details. With unfavorable new-crop prospects in the spring, larger net exports are probable; with favorable prospects, net exports may be smaller.

The Price Outlook

For the next few months we anticipate no pronounced shift in the level of world wheat prices (as indicated by sales of parcels in the United Kingdom) prevailing throughout November and December. The significant crops have been reported; for several weeks a fairly easy international position has been recognized; and fluctuations, as in December–April 1926–27, bid fair to be of small amplitude. Merchandising rather than a shift in the international position again promises to govern the price movement. Importers are unlikely, for several months at least, to purchase with distinctly more avidity than was shown in November; and exporters are unlikely to press their offers. The principal bullish factors seem likely to be downward revisions in Canadian and European crop estimates, while the only noteworthy bearish influence may be the pressure of Argentine wheat when it moves heavily in February and March. The price of wheat is already

somewhat lower than in the preceding three years, and the international position hardly appears so easy as to induce further declines.

In the United States the revival of milling demand and reduction of visible supplies will be conducive to higher prices. Canadian wheat of the higher grades may command increasingly large premiums, unless the Argentine crop proves of unusual quality. In Canada, moreover, the price movement after a large crop is apparently seasonally upward after the turn of the year. As was the case last year in December–April, when no dominant influence was in evidence, prices in various countries will probably move diversely. But by May or June new-crop prospects, which cannot now be foreseen, will probably begin to exert an influence on prices.

This issue is the work of M. K. Bennett, with the advice of Joseph S. Davis and Alonzo E. Taylor, and the aid of Margaret Milliken, Janet Murray, and Katherine Merriam

APPENDIX

Table I.—Wheat Production in Principal Producing Areas, 1920–27*

(Million bushels)

Year	United States	Canada	India	Australia	Argentina	Chile	Uruguay	Hungary	Bulgaria	Jugo-Slavia	Roumania	Soviet Russia	Mexico
1920.....	833.0	263.2	377.9	145.9	156.1	23.2	7.8	37.9	30.0	43.0	61.3	.....	15.0
1921.....	814.9	300.9	250.4	129.1	191.0	23.6	10.0	52.7	29.2	51.8	78.6	.....	5.1
1922.....	867.6	399.8	367.0	109.5	195.8	25.9	5.2	54.7	32.6	44.5	92.0	.....	13.6
1923.....	797.4	474.2	372.4	125.0	247.8	28.1	13.3	67.7	29.1	61.1	102.1	.....	13.7
1924.....	864.4	262.1	360.6	164.6	191.1	24.5	9.9	51.6	24.7	57.8	70.4	.....	10.4
1925.....	676.4	411.4	331.0	114.5	191.1	26.6	10.0	71.7	49.6	78.6	104.7	713.0	9.4
1926.....	831.0	409.8	324.7	160.9	220.8	23.3	10.2	74.9	41.1	71.4	110.9	809.6	10.3
1927.....	871.7	444.3	334.1	115.0	240.0	....	....	75.8	47.4	56.5	96.8	.....	11.5
Average													
1909–13.....	690.1	197.1	351.8	90.5	147.1	20.1	6.5[a]	71.5	37.8	62.0	158.7[a]	758.9	11.5[a]
1922–26.....	807.4	391.5	351.1	134.9	209.4	25.7	9.7	64.1	35.4	62.7	96.0	.....	11.5

Year	Morocco	Algeria	Tunis	Egypt	British Isles	France	Germany	Italy	Belgium	Netherlands	Denmark	Norway	Sweden
1920.....	17.9	16.2	5.2	31.7	56.8	236.9	82.6	141.3	10.3	6.0	7.4	1.00	10.3
1921.....	23.2	28.5	9.0	37.0	73.8	323.5	107.8	194.1	14.5	8.6	11.1	.97	12.3
1922.....	12.9	18.9	3.7	36.6	65.2	243.3	71.9	161.6	10.6	6.2	9.2	.64	9.5
1923.....	20.0	35.8	9.9	40.7	58.4	275.6	106.4	224.8	13.4	6.2	8.9	.59	11.0
1924.....	28.7	17.2	5.2	34.2	53.9	281.2	89.2	170.1	13.0	4.7	5.9	.49	6.8
1925.....	23.9	32.7	11.8	36.2	53.7	330.8	118.2	240.8	14.5	5.6	9.7	.49	13.4
1926.....	16.2	23.6	13.0	37.2	52.2	231.8	95.4	220.6	12.8	5.5	8.8	.59	12.4
1927.....	24.8	27.6	5.5	44.3	53.1[b]	284.4	113.6	195.8	14.4	5.4	....	.58	11.3
Average													
1909–13.....	17.0	35.2	6.2	33.7	59.6	325.6	131.3	184.4	15.2	5.0	6.3	.31	8.1
1922–26.....	20.3	25.6	8.7	37.0	56.7	272.5	96.2	203.6	12.9	5.6	8.5	.56	10.6

Year	Spain	Portugal	Switzerland	Austria	Czecho-Slovakia	Poland	Finland	Latvia	Esthonia, Lithuania	Greece	Japan, Chosen	South Africa	New Zealand
1920.....	138.6	10.4	3.6	5.4	26.4	22.7	.27	.39	2.58	11.2	41.1	7.6	6.9
1921.....	145.1	9.3	3.8	6.5	38.7	37.4	.58	.78	3.34	10.3	39.8	8.7	10.6
1922.....	125.5	10.0	2.5	7.4	33.6	42.4	.71	.96	4.17	9.0	39.2	6.3	8.4
1923.....	157.1	13.2	3.8	8.9	36.2	49.7	.69	1.64	3.70	8.8	35.2	6.0	4.2
1924.....	121.8	8.6	3.1	8.5	32.2	32.5	.79	1.58	3.86	8.3	37.3	7.1	5.4
1925.....	162.6	11.5	3.5	10.7	39.3	57.8	.93	2.16	6.08	14.2	40.0	7.8	4.6
1926.....	146.6	8.5	4.0	9.4	34.1	47.1	.92	1.86	5.02	11.2	39.9	8.5	7.5
1927.....	145.6	11.3	4.3	10.4	37.9	54.6	.90	2.18	5.39[c]	13.3	37.8	...	....
Average													
1909–13.....	130.4	11.8[d]	3.3	12.8	37.9	63.7	.14	1.48	3.63	16.3[d]	32.0	6.0[d]	6.9
1922–26.....	142.7	10.4	3.4	9.0	35.1	45.9	.81	1.64	4.57	10.3	38.3	7.1	6.0

* Data of U.S. Department of Agriculture. For 1909–13, including U.S. Department of Agriculture estimates for area within post-war boundaries. Dots (....) indicate that data are not available.

[a] Four-year average.

[b] England and Wales.

[c] Includes estimate for winter wheat only for Esthonia.

[d] One year only.

TABLE II.—MONTHLY WHEAT RECEIPTS AT PRIMARY MARKETS IN THE UNITED STATES AND CANADA*

(Million bushels)

Month	United States primary markets				Fort William and Port Arthur				Vancouver			
	1924–25	1925–26	1926–27	1927–28	1924–25	1925–26	1926–27	1927–28	1924–25	1925–26	1926–27	1927–28
Aug.	93.0	43.3	71.6	81.6	1.3	1.2	1.5	2.4	.21	.55	.12	.09
Sept.	82.1	57.9	48.7	79.7	7.1	45.7	32.8	8.6	.41	.28	.29	.32
Oct.	88.0	36.1	37.1	73.2	40.9	53.2	56.1	51.4	3.98	7.04	6.37	6.17
Nov.	60.5	34.1	29.8	44.8	42.7	51.5	60.5	71.0	5.05	9.79	7.22	....
Aug.–Nov.	323.6	171.4	187.2	279.3	92.0	151.6	150.9	133.4	9.65	17.66	14.00	....
Dec.	36.3	34.9	22.4	....	20.3	53.5	26.3	....	4.21	6.14	6.63	....
Jan.	24.7	21.6	24.6	....	4.1	10.5	14.0	....	3.84	10.03	6.83	....
Feb.	19.9	16.2	21.0	....	6.2	4.0	8.6	....	2.08	7.74	4.27	....
Mar.	17.3	15.1	16.6	....	8.5	3.2	6.3	....	.74	6.98	5.94	....
Dec.–Mar.	98.2	87.8	84.6	....	39.1	71.2	55.2	....	10.87	30.89	23.67	....
Apr.	10.4	14.0	14.4	....	8.1	1.8	12.6	....	1.02	3.58	3.58	....
May	17.6	15.7	19.2	....	7.0	17.2	17.3	....	1.54	1.20	1.56	....
June	21.9	21.0	20.7	....	4.1	13.6	7.3	....	.74	.22	.61	....
July	41.8	77.0	58.8	....	6.7	6.4	10.7	....	.11	.27	.14	....
Apr.–July	91.7	127.7	113.1	....	25.9	39.0	47.9	....	3.41	5.27	5.89	....
Aug.–July	513.5	386.9	384.9	....	157.0	261.8	254.0	....	23.93	53.82	43.56	....

* United States data are unofficial figures compiled from *Survey of Current Business;* Canadian data are official figures from *Reports on the Grain Trade of Canada* and *Canadian Grain Statistics.* Vancouver figures include receipts at Prince Rupert after October 1, 1926.

TABLE III.—WEEKLY WHEAT RECEIPTS AT PRIMARY MARKETS IN THE UNITED STATES AND CANADA*

(Million bushels)

Month	United States				Fort William and Port Arthur				Vancouver			
	1924	1925	1926	1927	1924	1925	1926	1927	1924	1925	1926	1927
July	1.34	4.95	8.80	7.65	4.32	1.33	1.95	1.33	.42	.05	.05	.06
	6.92	7.59	13.79	8.54	4.55	1.80	2.04	2.07	.62	.05	.10	.07
	8.57	7.75	14.25	10.35	3.03	1.90	1.63	2.89	.30	.06	.06	.04
	10.05	11.67	19.26	11.35	1.73	1.31	1.19	3.10	.13	.03	.01	.02
	17.52	13.77	25.25	26.01	1.41	.97	.92	2.61	.11	.03	.05	.00
Aug.	22.86	11.04	23.63	24.37	.47	.38	.75	.95	.00	.28	.03	.07
	22.32	10.15	18.84	19.56	.29	.23	.22	.81	.00	.23	.02	.00
	21.89	8.98	13.92	16.41	.11	.24	.21	.35	.19	.02	.02	.00
	20.08	8.99	10.89	13.84	.14	.15	.15	.21	.02	.02	.03	.01
Sept.	19.45	11.29	12.92	14.88	.15	.59	1.12	.20	.01	.02	.06	.01
	20.37	13.13	12.47	16.09	.41	6.20	3.02	.23	.01	.01	.10	.03
	18.88	14.15	11.73	19.91	.87	13.27	6.69	1.01	.04	.09	.07	.07
	17.54	14.99	9.77	19.57	3.09	15.83	12.49	3.00	.17	.17	.03	.15
Oct.	17.52	12.37	9.21	20.07	7.92	16.39	13.51	5.19	.48	.29	.07	.07
	20.48	9.42	8.71	21.20	10.64	15.73	12.48	11.79	1.12	1.12	.24	.33
	20.11	7.53	7.30	17.52	8.67	10.72	10.82	11.54	.84	1.86	.75	.36
	19.85	6.19	8.68	14.82	7.64	9.85	13.59	8.71	.91	1.93	1.90	1.61
	19.09	6.72	9.38	14.03	10.07	10.35	14.37	13.30	.79	1.64	2.92	2.75
Nov.	17.05	7.95	8.27	14.02	9.88	8.88	12.46	19.27	.94	2.46	3.33	3.38
	13.61	7.18	7.21	10.24	9.88	10.80	14.16	18.21	1.73	2.53	1.45	2.15
	13.37	8.68	6.59	10.54	9.41	13.67	15.00	14.30	1.50	2.10	.92	2.56
	13.29	8.70	5.86	7.91	10.61	14.42	14.92	15.18	.75	2.69	1.60	2.12

* United States data are unofficial figures compiled from *Price Current-Grain Reporter;* Fort William and Port Arthur data are official figures for *net* receipts furnished by Canadian Board of Grain Commissioners; Vancouver data are official figures compiled from *Canadian Grain Statistics.* United States and Fort William and Port Arthur figures begin with weeks ending July 5, 1924, July 4, 1925, July 3, 1926, and July 2, 1927; Vancouver figures are for weeks ending one day earlier. Beginning October 1, 1926, Vancouver figures include receipts at Prince Rupert.

TABLE IV.—WEEKLY VISIBLE SUPPLIES OF WHEAT IN NORTH AMERICA, UNITED KINGDOM PORTS, AND AFLOAT TO EUROPE, AUGUST–DECEMBER 1927*

(Million bushels)

Date	United States	Canada	U.K. ports	Afloat to Europe	Total	Date	United States	Canada	U.K. ports	Afloat to Europe	Total
Aug. 6	50.5	40.2	....	46.1	136.8	Oct. 8	90.6	37.9	9.4	49.0	186.9
13	59.5	37.0	6.1	44.4	147.0	15	96.1	45.0	8.6	49.7	199.4
20	63.8	32.1	7.2	43.9	147.0	22	95.0	56.8	8.4	49.8	210.0
27	68.2	29.5	7.2	43.1	148.0	29	98.7	70.4	8.6	53.1	230.8
Sept. 3	71.9	25.3	10.4	44.0	151.6	Nov. 5	99.0	89.5	9.0	56.1	253.6
10	75.0	21.9	10.0	43.8	150.7	12	103.7	102.5	10.0	56.5	272.7
17	80.8	21.0	9.7	45.3	156.8	19	99.3	109.7	10.4	57.4	276.8
24	85.8	24.4	10.2	47.3	167.7	26	100.8	115.6	10.1	58.2	284.7
Oct. 1	88.8	32.5	10.0	50.1	181.4	Dec. 3	100.0	124.0	9.6	57.1	290.7

* United States data from *Bradstreet's;* Canadian data from *Canadian Grain Statistics;* United Kingdom and Afloat data from Broomhall's *Corn Trade News.* Canadian figures are adjusted to bring item for western country elevators in correct week, and are for days preceding dates indicated in above table.

TABLE V.—WORLD VISIBLE WHEAT SUPPLIES, DECEMBER 1, 1920–26, AND MONTHLY, AUGUST–DECEMBER 1927*

(Million bushels)

Date	United States	Canada	Argentina	Australia	United Kingdom ports	Afloat to Europe	North America	Argentina, Australia	U.K. and afloat	Grand total	Total ex-Australia
1920 Dec. 1	92.2	51.9	.1	6.5	31.6	36.6	144.1	6.6	68.2	218.9	212.4
1921 Dec. 1	107.9	76.6	3.1	6.7	11.1	42.4	184.5	9.8	53.5	247.8	241.1
1922 Dec. 1	125.4	89.3	2.9	10.0	4.5	56.2	214.7	12.9	60.7	288.3	278.3
1923 Dec. 1	139.2	110.5	2.9	1.0	7.8	51.8	249.7	3.9	59.6	313.2	312.2
1924 Dec. 1	168.7	77.1	4.4	2.0	14.3	59.2	245.8	6.4	73.5	325.7	323.7
1925 Dec. 1	109.6	104.5	3.7	.7	3.8	35.1	214.1	4.4	38.9	257.4	256.7
1926 Dec. 1	133.0	123.0	1.8	2.0	3.6	36.9	256.0	3.8	40.5	300.3	298.3
1927 Aug. 1	65.9	42.7	5.9	12.7	7.8	46.1	108.6	18.6	53.9	181.1	168.3
Sept. 1	108.7	27.4	4.8	9.7	10.4	44.0	136.1	14.5	54.4	205.0	195.3
Oct. 1	143.7	22.2	4.4	6.8	10.0	50.0	165.9	11.2	60.0	237.1	230.3
Nov. 1	156.0	72.0	4.1	3.0	8.6	56.0	228.0	7.1	64.7	299.7	296.7
Dec. 1	154.7	120.9	3.7	.8	9.6	57.1	275.6	4.5	66.7	346.7	346.0
Average, Dec. 1											
1910–14	111.7	35.2	.5	.6[a]	18.6	36.0	146.9	....	54.6	.....	202.0
1922–26	135.2	100.9	3.2	3.1	6.8	47.8	236.1	6.3	54.6	297.0	293.9

* A joint compilation by Broomhall, the *Daily Market Record,* Minneapolis, and the *Daily Trade Bulletin,* Chicago; here summarized from Broomhall's *Corn Trade News* and the *Daily Trade Bulletin.* Includes some flour stocks.

[a] Australian figure for one year only.

TABLE VI.—CHANGES IN TOTAL FLOUR STOCKS IN THE UNITED STATES (EXPRESSED AS DEVIATIONS FROM A FOUR-YEAR AVERAGE), MONTHLY FROM JULY 1923*

(Thousand barrels)

Crop year	July 1	Aug. 1	Sept. 1	Oct. 1	Nov. 1	Dec. 1	Jan. 1	Feb. 1	Mar. 1	Apr. 1	May 1	June 1
1923–24	—2,855	—3,285	—1,906	— 519	+1,438	+1,853	+ 697	+ 371	+ 175	— 534	—1,373	—2,180
1924–25	—3,056	—3,032	—1,710	+ 49	+2,111	+2,308	+1,953	+3,147	+3,467	+1,465	— 492	—2,224
1925–26	—3,004	—2,834	—2,158	— 438	+1,652	+2,334	+2,392	+2,306	+1,760	+1,193	— 15	—1,576
1926–27	—2,211	—1,518	— 446	+1,096	+2,301	+2,572	+1,892	+1,063	+ 571	+ 139	— 877	—2,103
1927–28	—2,797	—3,856	—3,857	—2,941	—2,022[a]	.....	.....	.....	.....	.....	.....	.....

* The above estimates for changes in total flour stocks are derived by subtracting estimated consumption from domestic disappearance, and expressing the result in terms of deviations from the four-year average, July 1923–June 1927. For detailed explanation of the method of derivation of these estimates, see WHEAT STUDIES, IV, 74–77.

[a] Preliminary.

TABLE VII.—INTERNATIONAL TRADE IN WHEAT AND FLOUR, MONTHLY, JULY–NOVEMBER 1927*

(Million bushels)

A.—NET EXPORTS

Month	United States	Canada	India	Australia	Argentina	Chile	Hungary	Jugo-Slavia	Poland	Algeria	Tunis	Egypt
July	11.6	8.6	5.12[a]	8.1	9.9	....	1.26	.06	(.42)[b]	(.26)[b]	(.10)[b]	(.47)[b]
Aug.	27.5	14.5	1.57[a]	4.1	5.9	....	2.99	.23	(.08)[b]	.51	(.09)[b]	(.51)[b]
Sept.	39.0	17.1	.81[a]	4.2	5.4	....	3.28	....	(.10)[b]	.26	(.18)[b]	(.56)[b]
Oct.	34.7	23.4	.74	2.3	5.3	....	2.57	....	(.45)[b]	(.19)[b]	(.27)[b]	(.60)[b]
Nov.	24.8	57.9	....	...	....	....	....	....	....	....	....	....

B.—NET IMPORTS

Month	Irish Free St.	United Kingdom	France	Germany	Belgium	Italy	Netherlands	Scandinavia	Switzerland	Czecho-Slovakia	Baltic States[c]	Japan
July	1.70	17.33	10.00	10.19	3.62	7.59	2.02	2.06	1.43	1.56	.63	1.16[a]
Aug.	1.10	20.78	7.74	6.48	3.50	3.92	2.10	1.86	1.45	2.26	.57	.27[a]
Sept.	1.82	19.59	7.20	7.22	3.67	2.96	2.80	2.35	1.30	1.62	.70	.34[a]
Oct.	1.70	15.18	5.14	9.23	4.12	3.04	3.38	2.18	1.67	1.82	.78	.24

* Data from official sources and International Institute of Agriculture.
[a] Gross, not net. [b] Net import. [c] Finland, Esthonia, Latvia.

TABLE VIII.—WEEKLY WHEAT AND FLOUR SHIPMENTS BY AREAS OF ORIGIN AND DESTINATION, AUGUST–NOVEMBER 1927*

(Million bushels)

Week ending	North America	Argentina, Uruguay	Australia	Russia	Danube	India	Other countries	Total	To Europe	To ex-Europe
Aug. 6	6.13	1.70	1.02	...	.06	.43	.48	9.82	8.39	1.43
13	7.46	1.85	.92	...	...	.11	.44	10.78	9.14	1.64
20	9.21	.86	1.87	...	.02	.36	.36	12.68	10.70	1.98
27	9.93	1.18	1.50	...	.13	.50	.60	13.84	12.34	1.50
Sept. 3	10.80	1.20	1.09	...	.09	.26	.70	14.14	12.38	1.76
10	10.03	.95	.70	...	.32	.14	.59	12.73	10.98	1.75
17	12.74	.94	.74	...	.76	...	.43	15.61	14.00	1.61
24	11.80	1.12	.85	.05	.10	.42	.56	14.90	13.01	1.89
Oct. 1	14.25	1.57	1.17	.26	.14	...	.66	18.05	15.14	2.91
8	9.57	1.45	.79	.18	.20	.58	.84	13.61	11.19	2.42
15	12.17	.65	.44	.20	.10	...	.96	14.52	13.47	1.05
22	12.41	1.50	.50	.51	.39	.06	.84	16.21	13.68	2.53
29	14.34	1.36	.44	.55	.10	.10	.89	17.78	15.92	1.86
Nov. 5	14.82	.90	.50	.99	.07	.15	.79	18.22	16.79	1.43
12	13.20	1.35	.38	.82	.07	.01	.98	16.81	15.06	1.75
19	13.27	.80	.38	.08	.06	.21	.91	15.71	13.91	1.80
26	12.86	1.76	.30	.22	.15	.14	1.11	16.56	14.78	1.78

* Here converted from data in Broomhall's *Corn Trade News*. Broomhall's weekly figures do not always check with his cumulative totals, which presumably include later revisions.

TABLE IX.—WEEKLY CASH PRICES OF REPRESENTATIVE WHEATS IN LEADING EXPORTING AND IMPORTING MARKETS, AUGUST–NOVEMBER 1927*

(U.S. dollars per bushel)

Month	United States				Canada		Argentina	Liverpool					
	No. 2 Red Winter (St. Louis)	No. 2 Hard Winter (Kansas City)	No. 1 Dark Northern (Minneapolis)	No. 2 Amber Durum (Minneapolis)	No. 1 Manitoba (Winnipeg)	No. 3 Manitoba (Winnipeg)	Barletta (Buenos Aires)	No. 1 Manitoba	No. 3 Manitoba	Pacific White	No. 2 Winter	Argentine Rosafe	Australian
Aug.	1.37	1.33	1.55	1.52	1.58	1.45	1.46	1.78	n.q.	1.58	1.55	1.64	1.63
	1.43	1.37	1.60	1.64	1.64	1.50	1.47	1.81	1.69	1.59	1.57	1.66	1.63
	1.44	1.38	1.54	1.61	1.63	1.45	1.47	1.83	1.66	1.58	1.56	1.63	1.63
	1.46	1.37	1.49	1.43	1.59	1.42	1.47	1.82	1.63	1.58	1.53	1.59	1.64
Sept.	1.43	1.32	1.44	1.34	1.54	1.37	1.46	1.76	1.58	1.56	1.50	1.55	1.64
	1.45	1.32	1.43	1.35	1.50	1.35	1.44	1.77	n.q.	1.53	1.52	1.54	1.63
	1.42	1.29	1.36	1.26	1.42	1.28	1.42	1.70	1.55	1.49	1.47	1.53	1.60
	1.40	1.29	1.34	1.22	1.43	1.29	1.40	1.70	1.55	1.49	1.48	1.52	1.58
Oct.	1.43	1.31	1.36	1.23	1.41	1.29	1.41	1.64	1.57	1.52	1.48	1.52	1.59
	1.49	1.32	1.33	1.22	1.44	1.30	1.41	1.66	1.57	1.46	1.49	1.52	1.57
	1.47	1.31	1.36	1.26	1.47	1.31	1.40	1.70	1.56	1.50	1.50	1.53	1.58
	1.42	1.28	1.37	1.24	1.45	1.26	1.40	1.69	1.47	1.47	1.47	1.50	1.57
	1.41	1.25	1.31	1.20	1.41	1.22	1.39	1.64	1.46	1.45	1.45	1.49	1.56
Nov.	1.43	1.28	1.32	1.21	1.40	1.21	1.38	1.65	1.47	1.45	1.45	1.49	1.55
	1.42	1.30	1.35	1.30	1.42	1.22	1.41	1.71	1.48	1.45	1.46	1.50	1.55
	1.42	1.31	1.33	1.30	1.49	1.26	....	....	1.51	....	....	1.52	....
	1.42	1.34	1.34	1.28	1.50	1.28	....	....	1.49	....	....	1.50	....

* United States prices are weekly averages of daily weighted prices for weeks ending Friday, compiled from *Crops and Markets*. Canadian prices are averages for weeks ending Saturday, compiled from *Canadian Grain Statistics*. Liverpool and Argentine prices are Friday prices from *International Crop Report and Agricultural Statistics*, except Rosafé and No. 3 Manitoba at Liverpool which are for Tuesday of the same week and are from Broomhall's *Corn Trade News*.

TABLE X.—MONTHLY PRICES OF DOMESTIC WHEAT IN EUROPE, FROM AUGUST 1925*

(U.S. dollars per bushel)

Month	Great Britain			France (Chartres)			Italy (Milan)			Germany (Berlin)		
	1925–26	1926–27	1927–28	1925–26	1926–27	1927–28	1925–26	1926–27	1927–28	1925–26	1926–27	1927–28
Aug.	1.53	1.76	1.63	1.62	1.61	1.75	1.88	1.85	1.75[a]	1.55	1.75	1.78[b]
Sept.	1.48	1.46	1.43	1.57	1.77	1.57	1.94	2.03	1.73	1.38	1.71	1.68
Oct.	1.34	1.48	1.37	1.48	1.88	1.54	1.94	2.21	1.77	1.37	1.72	1.62
Nov.	1.45	1.62	1.32	1.37	1.96	....	1.99	2.20	....	1.49	1.78	....
Dec.	1.60	1.55	....	1.33	1.78	....	2.12	2.31	....	1.62	1.74	....
Jan.	1.60	1.55	....	1.39	1.88	....	2.17	2.13	....	1.61	1.72	....
Feb.	1.54	1.54	....	1.42	1.81	....	2.16	2.11	....	1.60	1.72	....
Mar.	1.51	1.52	....	1.39	1.70	....	2.14	2.11	....	1.66	1.73	....
Apr.	1.57	1.50	....	1.40	1.82	....	2.20	2.02	....	1.87	1.76	....
May	1.75	1.58	....	1.39	1.91	....	2.19	2.16	....	1.92[c]	1.92	....
June	1.77	1.65	....	1.52	1.88	....	2.20	1.99	....	n.q.	1.96[d]	....
July	1.84	1.64	....	1.53	1.81	....	1.98	1.80	....	n.q.	n.q.	....

* Data for Great Britain are averages of weekly average *Gazette* prices as given in the *Economist;* for France, averages of Saturday prices furnished directly by Federal Reserve Board; for Italy, averages of Friday prices of soft wheat as given in *International Crop Report and Agricultural Statistics;* for Germany, monthly average prices as given in *Wirtschaft und Statistik*. All data are converted, for convenience, from the domestic currency in which they are quoted in the above sources into U.S. money by monthly average exchange rates. "n.q." signifies no quotation.

[a] Three-week average.
[b] Second half of August.
[c] First half of May.
[d] First half of June.

TABLE XI.—APPROXIMATE DISPOSITION OF WHEAT SUPPLIES IN FOUR LEADING EXPORTING COUNTRIES, 1923–24 TO 1927–28*

(Million bushels)

Item	United States (July–June)					Canada (August–July)				
	1923–24	1924–25	1925–26	1926–27	1927–28	1923–24	1924–25	1925–26	1926–27	1927–28
Initial stocks	153	167	136	111	138	29	41	26	35	48
New crop	797	864	676	831	872	474	262	411	410	444
Total supplies	950	1,031	812	942	1,010	503	303	437	445	492
Net exports	135	258	95	209	225	346	192	324	292	317
Seed requirements	79	84	83	85	90	39	39	40	39	41
Consumed for food	477	479	492	492	502	42	42	42	44	44
Unmerchantable and lost in cleaning	92	74	31	18	38	31	22	18	31	35
Fed on farms						15	5	5	10	10
Apparent error in crop estimate						—11	—23	—27	—19	...
Stocks at end	167	136	111	138	155	41	26	35	48	45
Total disappearance	950	1,031	812	942	1,010	503	303	437	445	492

Item	Argentina (August–July)					Australia (August–July)				
	1923–24	1924–25	1925–26	1926–27	1927–28	1923–24	1924–25	1925–26	1926–27	1927–28
Initial stocks	56	63	57	67	61	42	38	36	30	41
New crop	248	191	191	221	240	125	165	115	161	115
Total supplies	304	254	248	288	301	167	203	151	191	156
Net exports	172	123	94	143	151	86	124	77	103	74
Seed requirements	21	23	25	24	25	10	11	11	12	12
Consumed for food	45	49	54	55	56	28	29	29	30	30
Feed and waste	3	2	8	5	4	5	3	4	5	5
Stocks at end	63	57	67	61	65	38	36	30	41	35
Total disappearance	304	254	248	288	301	167	203	151	191	156

* Based so far as possible upon official estimates for the various items of supply and disposition. Estimates for 1927–28 are preliminary. See text, pp. 125–27. For detailed explanation of our method of estimation and adjustment of items in the disposition table, see notes in WHEAT STUDIES, IV, 61 f.

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OF THE

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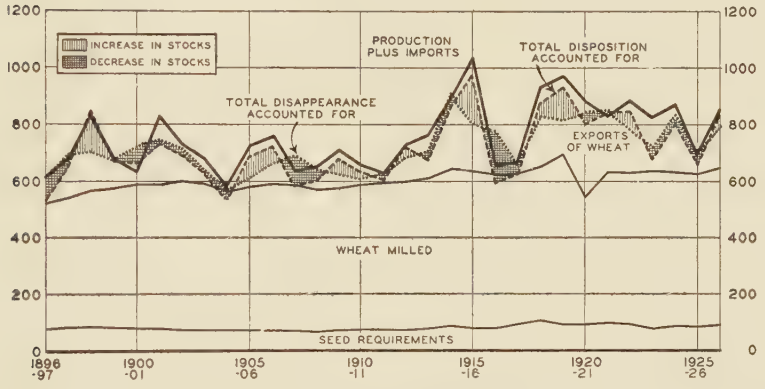
VOL. IV, NO. 4 FEBRUARY 1928

DISPOSITION OF AMERICAN WHEAT SINCE 1896

WITH SPECIAL REFERENCE TO CHANGES IN YEAR-END STOCKS

WHEAT SUPPLIES AND DISPOSITION IN THE UNITED STATES, 1896–97 TO 1926–27

(Million bushels)



Total production of wheat in the United States, plus imports, varies greatly from year to year, as shown by the heavy solid line on this chart. Quantities of wheat used for seed (shown by the lowest curve on the chart), and for seed and milling, together (shown by the second curve), vary little from year to year. Adding the exports gives the total disappearance accounted for (the line of round dots), which sometimes exceeds the production plus imports, and sometimes falls far short of the latter. Adding or subtracting changes in stocks between the beginning and the end of each year gives the total disposition accounted for (the line of short dashes), which follows quite closely the curve of production plus imports, leaving in most years a small margin unaccounted for, which theoretically represents feed and waste. The surplus from a large crop is absorbed by increased consumption only to a negligible extent; on the average, about half of such a surplus is exported and half absorbed in increases in stocks.

STANFORD UNIVERSITY, CALIFORNIA

February 1928

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OF THE

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STANFORD UNIVERSITY, CALIFORNIA

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The Food Research Institute was established at Stanford University in 1921 jointly by the Carnegie Corporation of New York and the Trustees of Leland Stanford Junior University, for research in the production, distribution, and consumption of food.

DISPOSITION OF AMERICAN WHEAT SINCE 1896

WITH SPECIAL REFERENCE TO CHANGES IN YEAR-END STOCKS

I. SUMMARY

Tabulations of the disposition of American wheat supplies over a period of years are of interest from at least three different points of view. First, they provide a record of the course of production, consumption, exports, and the other elements of disposition, satisfying the common desire to know what changes have taken place in these series over a period of years. Secondly, they furnish a basis for judgments, which must be formed anew each year, of the probable disposition of the current year's supplies, and of the prices to be expected from the current supply and demand situation. And finally, close study of the discrepancies between the statistics of supplies and of disposition in past years yields information on the defects and errors in the existing statistics—information which may be of the greatest value both in revealing the points at which current statistics are most in need of improvement, and in avoiding or removing mistaken interpretations of the data.

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We undertake here to bring together the best existing data on supplies and disposition of wheat in the United States by crop years beginning with 1896–97, providing a more complete and accurate record than has previously been available, and to point out some of the more important conclusions suggested by a study of the data. The tabulation of supplies and disposition here presented differs most notably from those previously in use in employing our recent independent estimates of wheat ground in the United States by crop years and improved data on year-end stocks of wheat, including estimates of stocks not covered by the existing statistics.

The most significant result of this compilation and analysis is the demonstration that changes from year to year in the quantity of old wheat carried into the new crop year are much more important than has generally been realized. It now appears that the actual changes in year-end stocks over most of the last 30 years have been nearly twice as great as has been indicated by the existing statistics. In their relation to the supply and demand situation these changes in year-end stocks rank in importance next to the changes in size of crop and on a par with the changes in exports. Between the beginning and the end of a single year as much as 173 million bushels of wheat have been added to the supplies for domestic consumption and export by merely reducing year-end stocks of old wheat. During the past 31 years there have been 20 in which stocks have been reduced and in 4 out of the 20 the reduction in stocks has amounted to over 50 million bushels. The absorption of wheat by increasing total stocks has run as high as 110 million bushels in one year of the last 31; and in the 11 years in which stocks were increased, the increase has 7 times exceeded 50 million bushels.

The importance of changes in stocks becomes clearer when viewed in its relation to the general supply and demand situation under varying conditions. Chart 1 (p. 136) presents the facts graphically. The wheat crop of the United States varies widely from year to year; the difference between crops of successive years has amounted to as much as 389 million bushels, and has exceeded 80 million bushels 16 times in the last 31

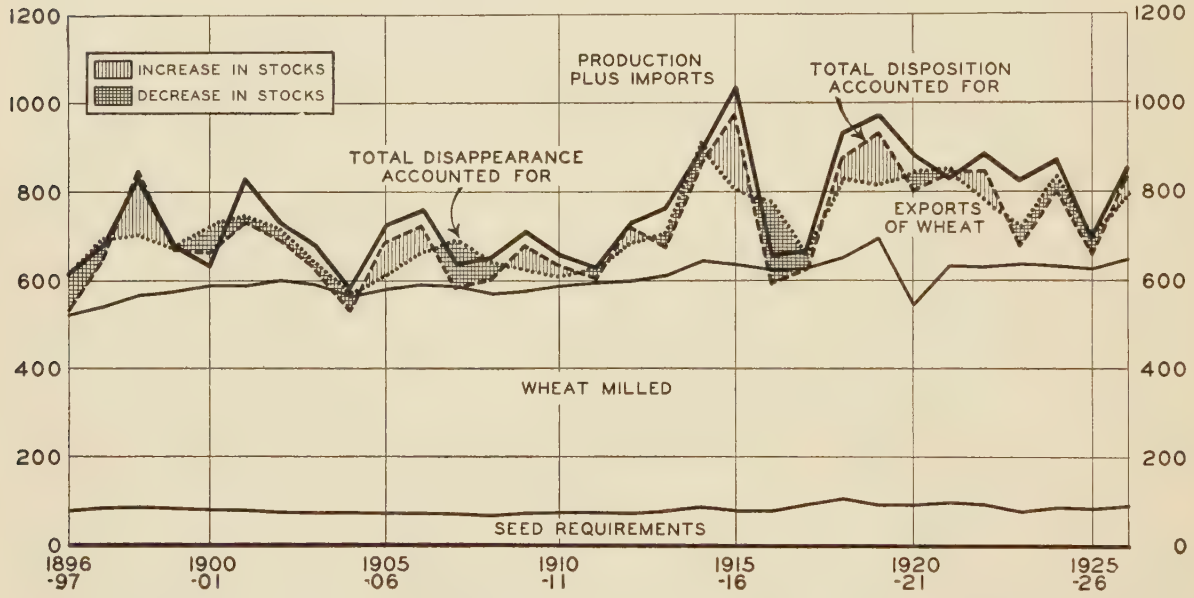
years. The quantity of wheat used for food in the United States, however, is practically unaffected by the supply and price situation. Seed requirements vary little from year to year, and though little is known of the variation in feed and waste, the changes from year to year can seldom exceed 20 or 30 million bushels. The variation in size of the crops must be absorbed almost entirely by variation in net exports and by reducing or increasing year-end stocks.

The important part played by exports in this respect is well known. It now appears, however, that changes in year-end stocks of wheat have played an equal part with variations in exports in absorbing the fluctuations in the crops. On the average the excess supplies from a large crop are absorbed nearly one-half by increased exports and one-half by additions to stocks, while the deficient supplies from a short crop are met about one-half by increased imports and reduced exports and again one-half by drawing down stocks. Nor does this statement reveal the full significance of changes in year-end stocks of wheat in the adjustment of supplies to demand. Export demand is sometimes weak in years of large United States crops or strong when crops are short. Then in years of large crops and weak foreign demand the excessive supplies are absorbed entirely by increasing stocks as in 1905–6 and 1915–16, while the difficult situation of short domestic supplies and strong export demand is met by heavy reductions in stocks, as in 1907–8 and 1916–17.

The foregoing conclusions are based upon existing statistics of wheat stocks, supplemented by somewhat rough, but conservative, estimates of the large element of stocks not covered by the earlier statistics. A complete and accurate record might well show changes in stocks playing an even more important part than is here indicated. In any case, it becomes clear that for an accurate judgment of the supply and demand situation in any year, the need for complete and accurate information on year-end stocks of wheat is nearly as great as the need for accurate statistics of production. This need has recently been recognized in

CHART 1.—WHEAT SUPPLIES AND DISPOSITION IN THE UNITED STATES, 1896–97 TO 1926–27*

(Million bushels)



* Data from Appendix Table I. Total disappearance accounted for is obtained by adding together seed requirements, wheat milled, and exports. The total disposition accounted for is the disappearance plus increases in stocks between the beginning and the end of each year, or minus decreases in stocks. This calculated total closely parallels the supplies from production and imports, with usually a small margin unaccounted for. The quantities milled and used for seed change little from year to year. The variation in the crops is absorbed about one-half by changes in exports and one-half by changes in stocks.

the United States, and the statistics of year-end stocks of wheat in this country seem now to have been rendered practically complete. For many countries, however, statistics of year-end stocks are almost entirely lacking.

Recognition of the part played by the changes in wheat stocks in adjusting annual supplies to the demand raises many questions. With few exceptions the decision to increase or to decrease stocks is left wholly to the judgment of individuals acting independently. Is the judgment generally good and are stocks wisely regulated or not? The level of stocks clearly depends to a large extent on the price situation and at the same time reacts strongly on wheat prices. But what, precisely, are the relations of wheat prices to the level of year-end stocks? Are there important factors other than wheat prices which bear on the level of stocks, and through them on the prices of wheat? If so, what are their effects? These are pressing problems, the existence of which has scarcely been recognized. The primary function of this study is to demonstrate the existence and the outstanding importance of these problems. To find the answers is a task for numerous further investigations.

The principal further conclusions to which the study has led are two. First, it appears that there are important errors in the statistics of supplies and disposition of wheat in the United States for even the more recent years. It is not possible to determine with certainty the source of the errors, but in our opinion the larger ones are in the production estimates. The Department of Agriculture has greatly improved its methods of preparing these estimates, but with the radical changes in wheat acreage in recent years, the task of obtaining accurate acreage estimates has been very difficult. It may well be that something approaching an annual census of wheat acreage will be required to remove the danger of occasional serious errors.

It appears also that there is need for more information on the amounts of wheat used for feed in the United States. Calculations of "feed and waste" obtained by deducting, from the statistics of supplies, the statistics and estimates for all the other items of disposition leave a balance subject to so much error that it cannot be regarded as reflecting actual feed and waste with any accuracy whatsoever. The quantity of wheat used for feed is presumably subject to considerable variation, and it is important to have some basis for estimating this element in the disposition. Independent statistics on feed and waste would serve a useful purpose also in making it possible to draw up a complete balance sheet with independent estimates of each of the items of supply and of disposition; and thus the presence of important errors in any of the statistics involved would be revealed more quickly and accurately.

Form of Disposition Tabulation

In bringing together the statistics of supplies and disposition in the following pages, we have adopted a plan of organization differing somewhat from that usually employed. Instead of starting with the statistics of stocks on hand at the beginning of the year, counted as part of the supplies, we leave stocks to be taken account of only at the end of the calculation, and then only in the form of *changes in stocks*. Total imports of wheat are added to the estimated production to obtain the apparent total supply of new wheat for the crop year. From this total are subtracted the several items of disappearance other than feed and waste, namely, the estimated requirements for seed, the estimates of total wheat ground, and the statistics of exports and other shipments out of the continental United States. From the remainder is deducted the amount of the increase in stocks between the beginning and the end of the year, if stocks were increased, or to it is added the amount of the decrease in stocks, if stocks were drawn down. The final figure thus obtained presumably represents feed and waste.

This method necessarily leads to the same final figures as would be obtained from the same data using the more common method in which stocks at the beginning of the year are included with supplies, and stocks at the end of the year are counted as one of the items of disposition. The more common method of calculation is undoubtedly simpler for most purposes, but when the attempt is made to follow it through the analysis of problems encoun-

tered in the following pages, it becomes much the more complicated and difficult of the two methods. The method here used has a further advantage in addition to its greater simplicity for present purposes: it emphasizes the one aspect of stocks which is important for a tabulation of disposition, namely, the changes in stocks between the beginning and the end of each crop year. If stocks stood at substantially the same levels at the close of each crop year, it would be quite immaterial whether stocks were included in the disposition tabulation or not. Only the changes in stocks are important, and by framing the disposition tabulation so as to include these changes explicitly, their significance becomes more readily apparent.

Method of Procedure

A brief preliminary outline of the method of procedure employed in the study may be of aid in following the successive steps as presented in subsequent pages. We assemble first the statistics of annual supplies and disappearance of wheat by crop years beginning with July 1, 1896,[1] and set up a tabulation of disposition in which "feed and waste" is treated as the residual item, obtained by subtracting all the other items of disposition from the total supply. Study of the resulting figures, together with other data, leads to the conclusion that the changes in "feed and waste" as thus calculated represent largely, not actual changes in feed and waste, but variations in the residual item consequent on the serious incompleteness of the statistics of changes in stocks used in the disposition tabulation. In short, changes in the apparent feed and waste represent chiefly changes in year-end stocks not covered by the statistics.

The deficiency in the statistics of changes in stocks we next undertake to remedy by finding a basis for estimating the changes not recorded in the statistics. This requires first a close examination of the existing statistics, a selection of the most useful series from among those available, and the compilation of two new series from the existing data. Then follows an analysis from which is derived a method of estimating the annual changes in stocks not covered by the statistics. The stocks omitted in the statistics before 1925 belong to the class commonly designated as "outside commercial" stocks. In the final presentation in Appendix Table I, changes in stocks are shown separately for the four classes: farm stocks, eastern terminal elevator stocks (at 18 principal points), Pacific Coast terminal stocks, and total outside commercial stocks. The data for the last class are our estimates of changes in all wheat stocks other than those included in the first three classes. Changes in flour stocks are not considered, since we are concerned here only with the balance of supplies and disposition of wheat as such. Appendix Table II shows the corresponding figures for total stocks in each of these classes on or about July 1 of each year.

The estimates of changes in stocks not covered by the earlier statistics complete the data necessary for the final revised tabulation of supplies and disposition, shown in Appendix Table I. The more important items of disposition are shown graphically in Chart 1 (p. 136). "Feed and waste" remains the residual item in the final tabulation, the term being kept in quotation marks to emphasize the fact, discussed at some length, that it is little more than a convenient designation for a residual item which may be of little significance as an indication either of the average magnitude or of the year-to-year changes in the actual quantities fed to live stock, or wasted.

II. SUPPLIES AND DISAPPEARANCE

As noted above, the present study makes use of a form of the disposition tabulation in which changes in year-end stocks of wheat are given directly as one of the items in the disposition, rather than indirectly through the inclusion of stocks at the beginning of the year and stocks at the end of the year. The items to be included in supplies are the production and the total (general) imports. The items to be included

[1] This date is made the starting point of the investigation because it is the first for which we have an estimate of farm stocks of wheat seemingly comparable with subsequent estimates. The first official estimate of year-end stocks on farms applies to July 1, 1895, but appears to be on a somewhat different basis from subsequent estimates.

in the disposition are (1) the exports, including shipments to possessions of the United States, and, during the war years, certain other shipments which were not included in the Department of Commerce figures; (2) wheat milled in the continental United States; (3) wheat used for seed; (4) feed, waste, and other miscellaneous forms of consumption; and (5) changes in stocks of wheat.

The first four items of disposition as listed above may conveniently be classed under the general term of *disappearance.* They stand on a different footing from the fifth item, changes in stocks, since they represent a final disposition—a complete disappearance of the product, as wheat—while disposition in the form of increased stocks represents only a temporary disposition. The total disposition in any individual year may be either larger or smaller than the total disappearance. The change in stocks is an item which may be either positive or negative. When stocks are increased between the beginning and the end of a crop year, the total disposition is greater than the total disappearance; when stocks are decreased, the total disappearance is greater than the total disposition.

Statistics of stocks of wheat and of changes in stocks, for all except the most recent years, are very incomplete, as will presently be shown. Statistics on feed and waste and on the other miscellaneous forms of consumption which we include with feed and waste as the fourth item in the disposition, are almost completely lacking. Statistics of supplies and of all the other items of disposition, while not so accurate as might be wished, appear by comparison to approach perfection. For the present, the available statistics of supplies and the statistics for the several items of disappearance other than feed and waste may be taken as they stand.

We accordingly bring these data together in the first seven columns of Appendix Table I, obtaining a statement for each crop year beginning with 1896–97 of the total supply (neglecting stocks of old wheat) and of the total disappearance, other than feed and waste. The data are shown graphically in Chart 2 (p. 140).

A conspicuous and important fact brought out by the statistics and appearing most clearly in the chart is that the domestic utilization of wheat in the United States, so far as it is reflected in these figures, does not change greatly from year to year. The changes in the disappearance arise chiefly from variations in the quantity of wheat exported. Indeed, even the relatively small changes in domestic utilization shown in this chart arise largely from changes in the quantity of wheat milled for export in the form of flour.[1]

In general, exports are large in years of large crops and small in years of small crops, but there are numerous exceptions. The correspondence between size of the crop and total exports is by no means close. Neither is there a close correspondence between total supplies and total disappearance other than feed and waste, as shown respectively by the heavy solid line and the line of round dots in Chart 2.

Imports, prior to 1915–16, were never sufficiently large to show on the chart, the maximum being slightly over 3 million bushels, recorded in 1904–5. Study of the figures, however, indicates that during this period, and indeed up to the end of the war, the volume of imports was closely related to the size of the domestic crop, large imports occurring only in years of unusually short crops. Since the war the larger fraction of the general imports has been entered for warehouse and subsequently milled in bond. The imports for consumption, however, have run many times larger than before the war; and the volume of such imports has been more closely related to the quality of the crop than to its size, Canadian wheat being imported chiefly to make up deficiencies in domestic supplies of high protein wheat.[2] The magnitude of the imports since 1915–16 is shown in the chart by the margin between the curve representing the domestic production and the curve showing the total supplies.

The compilation of the statistics of supplies and disappearance for Appendix Table I has required consideration of a

[1] See "Statistics of American Wheat Milling and Flour Disposition since 1879," WHEAT STUDIES, December 1927, IV, No. 2.

[2] This question has been discussed at length in "American Importation of Canadian Wheat," WHEAT STUDIES, November 1926, III, No. 1.

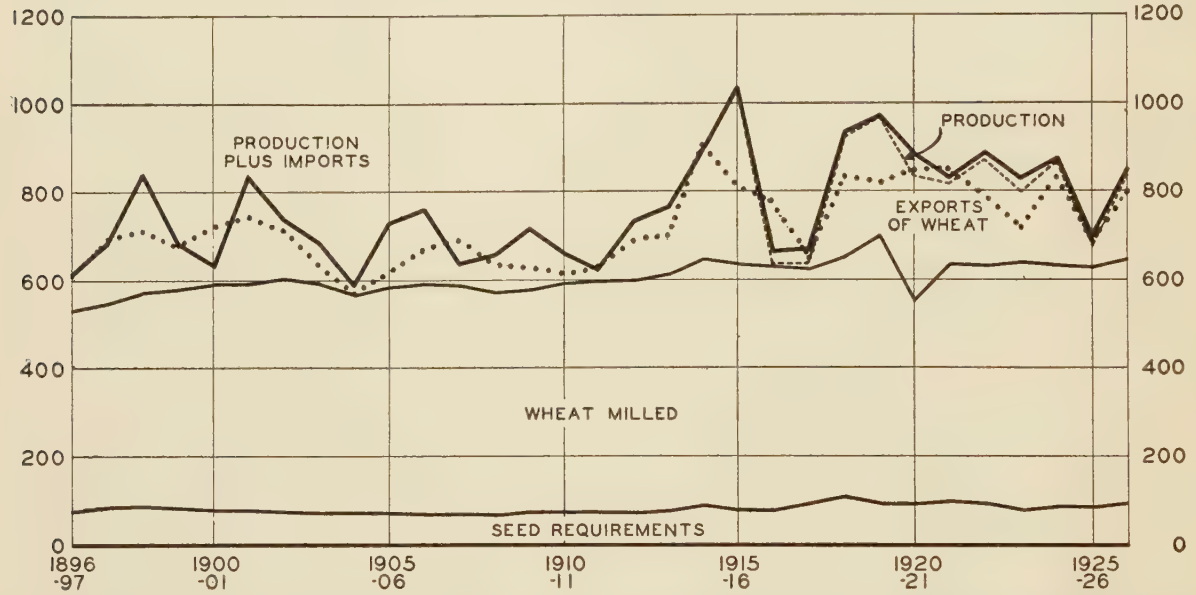
number of problems that should be mentioned for the benefit of those who study statistics of supplies and disposition critically. It is by no means easy to get together an entirely satisfactory and consistent series of such statistics over an extended period of years. When the statistics are to be analyzed closely, as in some of the following sections of this study, it is essential that they be as accurate and consistent as possible.

portant. In compiling the statistics of supplies, we have used the Food Research Institute figures for the years 1896–1910 inclusive and the latest official figures for subsequent years.

Statistics of imports of foreign wheat are available from the figures of the Bureau of Foreign and Domestic Commerce. It is most convenient and satisfactory, as a rule, to use the figures for "general imports" which presumably cover all wheat imported,

CHART 2.—SUPPLIES AND DISAPPEARANCE OF WHEAT IN THE UNITED STATES, 1896–97 TO 1926–27*

(Million bushels)



* Data from Appendix Table I. Prior to 1915–16 wheat imports were too small to show on the chart, but for subsequent years are reflected in the varying margin between the line of short dashes, representing production, and the heavy solid line representing the total supplies from production plus imports. Domestic utilization for seed and milling reflects little influence from the size of the crop. Even exports do not vary closely with the size of the crop. The variations in the margin between the total of these three items of disappearance (represented by the dotted line) and the total supply are taken up chiefly by increasing or decreasing year-end stocks.

The best available statistics of annual production from 1911 to date are the official estimates of the United States Department of Agriculture, as most recently revised. For years prior to 1911 there are available, in addition to the official estimates, the revised estimates of the Food Research Institute.[1] For the period 1902–10 the Food Research Institute estimates differ very little from the revised Department of Agriculture figures first published in 1918, but for earlier years the differences are im-

[1] Published in WHEAT STUDIES, June 1926, II, 260–61; see also pp. 237–39 and 256–58.

whether for domestic consumption, for re-export, or for grinding (in bond) into flour destined for export.

The statistics of general imports, prior to the last few years at least, appear to be not entirely complete. This fact appears clearly from a calculation of the annual excess of the general imports over the imports for consumption and the re-exports. The data are shown in Table 1. The general imports should always exceed the imports for consumption by an amount equal to the quantity imported and milled for export as flour, except as the balance is affected by changes in stocks of wheat in bonded warehouses.

Yet negative balances are common prior to 1921, and several of the negative balances

TABLE 1.—STATISTICS RELATING TO UNITED STATES IMPORTS OF WHEAT, 1896–1926*

(Thousand bushels)

Year	General imports	Re-exports	Imports for consumption	Excess of general imports[a]
July–June				
1896–1897	1,534	1,496	5	+ 33
1897–1898	2,047	1,874	10	+ 163
1898–1899	1,871	1,930	6	— 65
1899–1900	317	297	5	+ 16
1900–1901	600	596	5	— 1
1901–1902	119	45	31	+ 43
1902–1903	1,077	1,258	7	— 188
1903–1904	7	6	6	— 5
1904–1905	3,103	570	2,247	+ 286
1905–1906	58	33	123	— 98
1906–1907	375	597	19	— 241
1907–1908	342	308	32	+ 2
1908–1909	41	4	38	— 1
1909–1910	164	137	36	— 9
1910–1911	509	1	509	+ 1
1911–1912	2,699	1	2,684	+ 14
1912–1913	798	79	690	+ 29
1913–1914	1,979	746	1,038	+ 195
1914–1915	426	181	271	— 26
1915–1916	5,703	575	4,291	+ 837
1916–1917	24,139	54	22,879	+ 1,206
1917–1918	28,177	1,054	28,166	— 1,043
Jan.–Dec.				
1918	17,036	1,552	17,026	— 1,542
1919	7,911	95	7,924	— 108
1920	35,809	41	35,809	— 41
1921	23,286	741	21,707	+ 838
1922	22,642	52	10,560	+12,030
1923	19,502	96	8,930	+10,476
1924	15,534	30	6,895	+ 8,609
1925	13,901	212	1,308	+12,381
1926	14,143	184	451[b]	+13,508

* Data from *Monthly Summary of Foreign Commerce of the United States* and *Foreign Commerce and Navigation of the United States.*

[a] Excess over the sum of imports for consumption and re-exports; theoretically representing changes in warehouse stocks and withdrawals for milling in bond (see text, p. 140). Withdrawals for milling in bond are available for the last few fiscal years, as follows in thousand bushels:

1921–22	6,173	1924–25	5,813
1922–23	9,281	1925–26	13,470
1923–24	13,905	1926–27	13,172

[b] In *Foreign Commerce and Navigation* for 1926, p. 435, imports for consumption are shown in two classes: "for grinding in bond and export," 15,429,102 bushels; "other," 451,029 bushels. Wheat imported for grinding in bond and export has not previously been counted in the imports for consumption and is therefore excluded here.

are too large to be accounted for on the ground of a reduction in wheat stocks in bonded warehouses. These discrepancies can scarcely be due to overstatement in the figures for either the imports for consumption or the re-exports; it seems much more probable that they arise from understatements in the figures for general imports.

The statistics for each year since 1921 show a large balance of general imports over the sum of imports for consumption and re-exports. These balances may be checked against the statistics of withdrawals for milling in bond. Though the check is somewhat rough owing to the fact that the one set of figures applies to calendar years, the other to crop years, there is no evidence of discrepancies since 1922 at least.

Such defects as may exist in the import statistics are of small importance since total annual imports were so small prior to 1915 that the disposition tabulation would not be affected appreciably even though it were shown that total imports were twice as large as the statistics indicate. To minimize the possible understatement of imports, however, we have calculated for each year the sum of the imports for consumption plus the re-exports, and in Appendix Table I this sum has been used in place of the general imports figure wherever it is the larger.

For statistics of exports and shipments to possessions it is necessary to take the Department of Commerce figures as they stand. Some students of export statistics have held the view that the earlier United States statistics of exports, at least, are by no means complete, but we know of no specific evidence of incompleteness in the statistics of wheat exports, and there appears in any case to be no way of materially improving upon the existing figures. Since the import statistics employed are the "general imports," the statistics of exports of both foreign and domestic wheat must be employed. Foodstuffs shipped to the various relief organizations during the war and to the American Expeditionary Forces were not included in the Department of Commerce exports. The flour shipments thus omitted in the export statistics aggregated over 6 million barrels, but the reported wheat shipments were insignificant, amounting to only 6,150 bushels.

The estimates of wheat milled, for this

tabulation, are those of the Food Research Institute,[1] and are believed to be accurate to within 2 or 3 per cent at least.

The data on wheat used for seed, beginning with 1900, are either the official estimates, which are obtained by allowing 1.38 bushels per acre of winter wheat sown and spring wheat harvested, or have been calculated directly by us on this basis. For the years 1900 to 1910 our revised acreage figures have been used as the basis for the calculation, separating the revised totals into winter and spring wheat in the proportion indicated by the Department of Agriculture's most recent estimates and accepting the Department's estimates of percentage abandonment of winter wheat to arrive at the winter-wheat acreage sown. For the years prior to 1900, in the absence of estimates of abandonment of winter wheat, the calculation has been made on the basis of our revised estimates of acreage harvested, allowing for the average abandonment of winter-wheat acreage by using a figure of 1.48 bushels of seed per acre harvested.

III. A TRIAL BALANCE

The total disposition of wheat in each year, taking due account of changes in year-end stocks, must necessarily equal the total supplies for the year. The disposition table for each year may be viewed as an accounting statement in which the supplies of new wheat stand in the place of receipts in a financial account, disappearance stands in the place of expenditures, and changes in stocks, in the place of "profit and loss." In practice, an accurate balance is not expected in the disposition tabulation, but a study of the discrepancies yields valuable information on the nature and magnitude of the errors in the statistics of supplies and disposition. Taken with other facts, we are able to obtain from it, indeed, a basis for supplementing the existing data where they are most defective.

Disposition Statistics

The statistics discussed in the previous section furnish all the data necessary for the supply side of a tabulation of supplies and disposition. The statistics of disappearance there presented omit two elements involved in the disposition: feed and waste (a further item in the disappearance) and changes in stocks.

For statistics of changes in year-end stocks we may take the statistics of stocks compiled by the United States Department of Agriculture two years ago,[2] brought down to date on a comparable basis. This seems to represent the most comprehensive statement available.[3]

Nothing is to be gained by including estimates of feed and waste in the disposition totals. No strictly independent official estimate of feed and waste has ever been made for the United States, so far as we are aware. The only approach to an official estimate of feed and waste are the estimates, prepared in 1923, of the percentage of the crop "usually" fed in the county where grown and the percentage to be fed in that year.[4] Other estimates are on varying bases and none can be regarded as more than a rough approximation. In this situation it is better to leave estimates of feed and waste out of the disposition totals entirely, and to make a corresponding change in the interpretation of discrepancies between the supply totals and the disposition totals. With feed and waste omitted from the disposition totals, it is to be expected that supplies should always be in excess of the disposition, as tabulated, by the amount of the feed and waste. The excess of supplies over disposition may be tentatively termed "feed and waste," keeping the words in quotation marks. The test of the accuracy and completeness of the statistics in the tabulation of supplies and disposition will

[1] Published in Wheat Studies, December 1927, IV, No. 2.

[2] *Wheat and Rye Statistics* (U.S. Department of Agriculture Statistical Bulletin 12), January 1926, Table 43.

[3] We know of no statistics of wheat stocks omitted in this compilation; in fact, it includes some duplication of statistics and a considerable quantity of flour counted as wheat. These defects are minor, however, and of no importance for present purposes since it will shortly be demonstrated that the totals, despite certain duplications, fall far short of equaling the actual total stocks of wheat.

[4] *Agriculture Yearbook, 1923,* p. 660.

then be found in the reasonableness or unreasonableness of the calculated "feed and waste" item.

"Feed and Waste"

Proceeding with the calculations suggested above, we may set down in the first column of Table 2 the total new supply of wheat for each year. In the second column is shown the total of the several items of disappearance previously discussed, and in the fourth column, the disappearance, other than feed and waste, plus (or minus) the changes in stocks shown by the statistics included in the Department of Agriculture compilation. This total, intended to include all the elements of disposition except feed and waste, is designated as "disposition, less feed and waste." Subtracting the fourth column from the first leaves a balance which should accurately represent feed and waste, provided the statistics employed in the calculation are complete and accurate. The uncertain significance of the figures, however, may be emphasized by keeping the term "feed and waste" in quotation marks.

Casual examination of the figures for "feed and waste" thus obtained reveals the presence of errors from some source. For three years the "feed and waste" is less than nothing. In five other years the figures are below 20 million bushels, while in eleven years they exceed 60 million bushels. The wide range in the figures is furthermore not the result of any marked upward or downward trend, for high and low figures are scattered irregularly throughout the series.

One explanation of the wide variation in the calculated feed and waste is suggested by a comparison of these figures with the statistics of changes in stocks. The relationship between the two sets of figures is most clearly apparent when the data are shown graphically, as in Chart 3 (p. 144). The dotted line connecting the circles, representing changes in stocks, is about as often below the zero line as above, since increases and decreases in stocks alternate with considerable regularity. The solid line connecting the dots, representing the calculated feed and waste, is usually above the zero line—barring errors and omissions in the data, it should remain always above. Apart from the differences in position on the chart, however, the two lines show a striking similarity. The calculated "feed and waste" is quite uniformly high in years in which stocks increased and low in years in which stocks decreased.

The tendency for the calculated "feed and waste" to be high or low according as stocks are increased or decreased suggests that the calculations are in error from an

Table 2.—Preliminary Tabulation of Supplies and Disposition of Wheat in the United States, 1896–97 to 1925–26

(Million bushels)

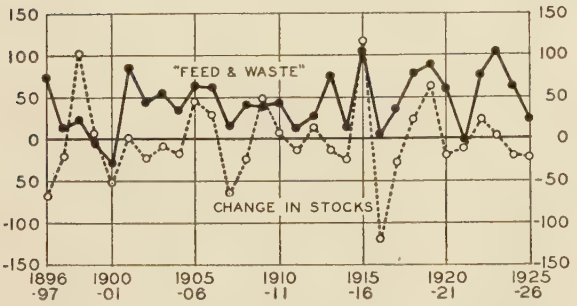
Year July–June	Supplies[a]	Disappearance other than feed and waste[a]	Change in statistics of stocks[b]	Disposition less feed and waste[c]	"Feed and waste"[d]
1896-1897.....	614.1	608.5	— 67.7	540.8	+ 73.3
1897-1898.....	687.0	695.6	— 21.2	674.4	+ 12.6
1898-1899.....	833.5	708.1	+ 99.5	808.0	+ 25.5
1899-1900.....	682.5	679.3	+ 6.6	685.9	— 3.4
1900-1901.....	639.2	720.9	— 52.9	668.0	— 28.8
1901-1902.....	829.0	740.9	+ 3.4	744.3	+ 84.7
1902-1903.....	739.2	715.6	— 21.0	694.6	+ 44.6
1903-1904.....	681.5	635.0	— 9.1	625.3	+ 56.2
1904-1905.....	584.1	567.6	— 16.8	550.8	+ 33.3
1905-1906.....	727.4	617.4	+ 46.4	663.8	+ 63.6
1906-1907.....	760.5	667.2	+ 30.1	697.3	+ 63.0
1907-1908.....	637.1	686.3	— 65.5	621.0	+ 16.1
1908-1909.....	654.5	637.3	— 23.8	613.5	+ 41.0
1909-1910.....	712.9	624.3	+ 45.2	669.5	+ 43.4
1910-1911.....	660.4	610.4	+ 7.6	618.0	+ 42.4
1911-1912.....	624.0	625.4	— 15.2	610.2	+ 13.8
1912-1913.....	731.1	689.9	+ 12.4	702.3	+ 28.8
1913-1914.....	765.4	701.5	— 13.1	688.4	+ 77.0
1914-1915.....	891.5	903.8	— 24.1	879.7	+ 11.8
1915-1916.....	1,031.5	809.5	+113.5	923.0	+108.5
1916-1917.....	660.5	774.6	—117.7	656.9	+ 3.6
1917-1918.....	665.9	656.0	— 24.0	632.0	+ 33.9
1918-1919.....	932.6	829.3	+ 20.3	849.6	+ 83.0
1919-1920.....	972.8	819.5	+ 60.4	879.9	+ 92.9
1920-1921.....	884.0	843.3	— 16.4	826.9	+ 57.1
1921-1922.....	829.4	842.5	— 12.4	830.1	— 0.7
1922-1923.....	885.6	785.8	+ 21.0	806.8	+ 78.8
1923-1924.....	824.7	717.6	+ 3.8	721.4	+103.3
1924-1925.....	870.6	826.4	— 19.8	806.6	+ 64.0
1925-1926.....	692.0	688.2	— 23.5	664.7	+ 27.3

[a] Data from Appendix Table I.
[b] Calculated from statistics of stocks shown in *Wheat and Rye Statistics* (U.S. Department of Agriculture Statistical Bulletin No. 12), January 1926, Table 43, and comparable statistics for years since 1924.
[c] Column 2, plus column 3.
[d] Column 1, minus column 4.

incomplete statement of the changes in stocks. If stocks are increased by 100 million bushels between the beginning and the end of a crop year, but only 60 million bushels of this increase appears in the statistics of stocks, the calculated disposition is 40 million bushels smaller than it should be. When this incomplete disposition figure is subtracted from the total supply there remains an item for apparent feed and waste that is 40 million bushels too large.

CHART 3.—CHANGES IN STATISTICS OF YEAR-END STOCKS AND PRELIMINARY CALCULATION OF "FEED AND WASTE," 1896–97 TO 1925–26*

(Million bushels)



* Data from Table 2 (p. 143). The wide variations in the calculated "feed and waste," corresponding closely with changes in the statistics of year-end stocks, demonstrate the incompleteness of the stocks statistics. When, for example, supplies are large, and year-end stocks are increased by 100 million bushels, then if only 60 million bushels of the increase appear in the statistics, the other 40 million bushels appear as an addition to "feed and waste" (the residual item in the tabulation of disposition).

Similarly, in years in which stocks are decreased more than the statistics indicate, the calculated "feed and waste" must be correspondingly too small.

The suspicion that the statistics of changes in stocks used in the foregoing computation are seriously incomplete, as suggested by the character of the variations in the calculated "feed and waste," might have been difficult to support a few years ago. It might be argued, for example, that actual feed and waste tends to be high in the years in which stocks are increased and low in years in which stocks are decreased. On this hypothesis, the variations in the calculated "feed and waste" shown in Table 2 and Chart 3 would be taken as indicative of real changes in feed and waste rather than as evidence of defects in the data on changes in stocks. This hypothesis is open to serious question on two grounds. First, it appears very doubtful whether actual feed and waste can vary as much as is indicated if these figures be taken as roughly indicative of the variations. In the absence of any direct information on variations in feed and waste, however, there is room for difference of opinion on this point. A clearer objection appears when the individual variations are studied in connection with the conditions existing in each year. The variations fail to conform at all uniformly with variations in price, with variations in quality of the crop, or, so far as we have been able to discover, with variations in any of the other influences commonly believed to affect the actual volume of feed and waste.

NEGLECTED STOCKS

Fortunately, it is not now necessary to pursue such an inconclusive line of argument to demonstrate the incompleteness of the statistics of wheat stocks used in the calculation in Table 2. Vigorous efforts on the part of the United States Departments of Agriculture and of Commerce to obtain complete statistics have brought to light surprising totals of stocks in excess of those covered by previous compilations. Most important has been the collection of statistics of mill stocks by the Department of Commerce, showing totals on June 30 ranging from 26 to 46 million bushels[1] in the past three years.

Of considerable importance also are the larger figures for terminal and interior elevator stocks shown by the recent figures of the Department of Agriculture. The most comprehensive figures previously obtainable were those given by combining *Bradstreet's* visible supply statement and the Department of Agriculture estimate for country mills and elevators. The Department of Agriculture now publishes a statement of "commercial grain stocks in store in principal United States markets," which showed 4 million bushels more wheat on July 2, 1927, than appeared in the Bradstreet visible.

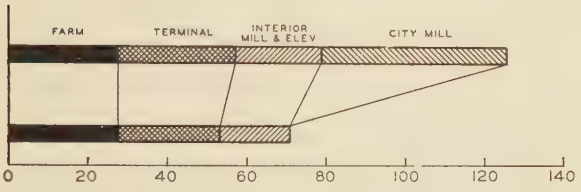
[1] Omitting stocks held by mills in country elevators and in public terminal elevators, presumably included also in other statistics of stocks.

Intended to supplement this statement of stocks in principal markets, without duplication, is the new estimate of stocks in "interior mills and elevators." Revising the estimate for July 1, 1926, to the new basis, the Department raised the former figures by 24 per cent.

The magnitude of the stocks "discovered" in the recent more complete compilation is strikingly demonstrated by a comparison of the total for July 1, 1927, in the three major classes, as shown by a compilation of the present data, with the total shown by a compilation of data from sources which were the most comprehensive available prior to 1925. The sections of the upper horizontal bar in Chart 4 represent

CHART 4.—WHEAT STOCKS ABOUT JULY 1, 1927, ON TWO BASES OF COMPILATION*

(Million bushels)



* The upper bar represents the total stocks of wheat in the United States on or about July 1, 1927, as shown by the best statistics now available; the lower bar represents the total stocks for the same date, as shown by statistics from the sources that were the most complete available prior to 1925. See text, pp. 144–45.

the total stocks in the various positions about July 1, 1927, as shown by the best figures now available. The data are drawn respectively from the Department of Agriculture estimate of farm stocks, the Department of Agriculture statement of "commercial stocks in principal markets," the Department of Agriculture estimate of interior mill and elevator stocks, and the Department of Commerce report of stocks held by mills either in their own elevators, in other private elevators, or in transit.

The lower bar represents the showing that would have been made for the same date using data from sources that were the most comprehensive available prior to 1925. The same figure is used for farm stocks as for the upper bar; the terminal stocks are represented by *Bradstreet's* statement of visible supplies; and the interior mill and elevator stocks are represented by the official estimate for 1927 reduced by 19 per cent, which is the amount that the original estimate for July 1, 1926, fell below the revised estimate for the same date when it was placed on the new basis. Prior to 1925 no figures were available on city mill stocks, which are, therefore, omitted from the lower bar.

FURTHER STEPS

Since the recent compilations of wheat stocks statistics clearly demonstrate the incompleteness of the earlier figures, we may turn to another aspect of the situation. The fact that "feed and waste," as calculated above (p. 143), appears large in years in which stocks are increased and small in years in which stocks are reduced, indicates not only that the "feed and waste" item is affected by changes in stocks not recorded in the statistics, but also that these unrecorded stocks must move fairly closely with the recorded stocks. This being the case, it should be possible to employ the existing statistics as a basis for estimating the approximate changes that have taken place in stocks not included in the statistics.

The possibility is worth testing. If the changes in unrecorded stocks can be estimated with fair accuracy, a considerably more complete and trustworthy picture will be obtained of the actual disposition of American wheat supplies since 1896.

To lay the basis for these proposed estimates of changes in stocks not covered by the statistics, some further investigation is necessary. First, it is wise to make certain of the reliability and consistency of the available statistics of stocks and to obtain the data separately for stocks in different classes of positions. Study of the degree of correspondence, in direction and amount, between changes in stocks in different positions over the period under consideration will give some indication of the probable degree of correspondence between changes in any one or more of the statistical series and the changes in stocks not covered by the statistics. The next two sections are accordingly devoted to a critical examination of the available data on year-end stocks, a compilation of statistics for further use, and a study of similarities of movement of stocks in different positions.

IV. STATISTICS OF CHANGES IN YEAR-END STOCKS

Available Sources

To provide a basis for the further study of changes in year-end stocks, it is necessary to review briefly the more important statistics available.[1] These may be considered, for the present, under the headings suggested by the common division of stocks into visible supply, outside commercial stocks, and farm stocks.

The visible supply statements currently published are those compiled by the New York Produce Exchange, by the Secretary of the Chicago Board of Trade, by *Bradstreet's*, and by the United States Department of Agriculture. The New York Produce Exchange statement of visible supplies antedated by several years any of the other statements of which we have record. Subsequently the Secretary of the Chicago Board of Trade began the collection of visible supply statistics, including supplies in Minneapolis and St. Paul, not covered in the New York statement, and *Bradstreet's* instituted a still more comprehensive weekly statement of stocks, with the result that the New York statement gradually fell into disuse. Though still published, it is not widely quoted.

The Chicago Board of Trade statement of visible supply has been prepared weekly since February 16, 1884,[2] and is now published in detail, usually on Monday, in the Chicago *Daily Trade Bulletin*, showing the stocks at each point of accumulation on the previous Saturday. The number of points is now 25, counting "on lakes" and "on canals" as points. The Bradstreet statement of visible supply has been compiled weekly since September 1, 1890, and is published on Saturday of each week in *Bradstreet's*, showing the stocks at each point of accumulation on the previous Saturday. The Bradstreet compilation has included from the beginning stocks at all the points covered in the Chicago statement and also stocks at a considerable number of additional points, bringing the total at the present time (January 1928) to 51, including three points west of the Rocky Mountains. The United States Department of Agriculture statement has appeared weekly on Mondays since August 1926, and gives stocks for the previous Saturday. The figures are not published by points, but totals are given separately for domestic grain and for Canadian grain in store in bond in United States markets. Stocks of domestic grains are given separately for three classes of points: Atlantic and Gulf ports, interior and lake ports, and Pacific ports. The totals shown run appreciably larger than those shown by either the Chicago statement or the *Bradstreet's* statement, chiefly because of the inclusion of reports from a considerable number of elevators not reporting for the other statements.[3] The points covered are said to number about 42, 17 more than are covered in the Chicago statement, but 9 less than covered in the *Bradstreet's* statement.

All of the visible supply series, with the possible exception of the short series of the United States Department of Agriculture, have been somewhat changed in significance on several occasions by revisions of the list of points included. Each of the visible supply statements represents principally stocks in public elevators at the points covered. Wheat afloat on the lakes and at ports and on rivers and canals is also included. Wheat in mills and mill elevators and wheat in private elevators, with some exceptions, is not included, nor are quantities in transit by rail.

For stocks of wheat in second hands outside the visible supply—the so-called "outside commercial" stocks—the most complete figures, prior to 1925, are the estimates prepared by the United States Department of Agriculture for stocks in country mills and elevators. The Department published its first estimate of July 1 stocks in country mills and elevators in

[1] Cf. also the discussion of the statistics of wheat and flour stocks in Wheat Studies, August 1925, I, 293–98. The description of the statistics in the following pages is written with a different purpose than the discussion in our earlier study, and while presenting additional information on some points, omits discussion of other points which may be of interest although not important for the purpose of this study.

[2] *Daily Commercial Bulletin* (Chicago), February 19, 1884.

[3] The scope of the reports is described in some detail in the *Agriculture Yearbook, 1926*, p. 766.

1919. In the summer of 1927 the Department revised the basis for these estimates and issued a new estimate for July 1, 1926, on the revised basis, which is about 24 per cent higher than the estimate on the old basis. The new estimates are designated as stocks of old-crop wheat in "interior mills and elevators."

The Chicago *Daily Trade Bulletin* and the Minneapolis *Daily Market Record* have published about the middle of each month since September 1891,[1] in their statement of "world's available supplies of breadstuffs," as of the first of the month, a report of stocks of wheat and of flour in the United States, tabulated, since the first few months of publication, by states or small groups of contiguous states. The data for the United States are compiled jointly by the two publications. This statement frequently includes a small element of estimated stocks, but is primarily a tabulation of actual reports of stocks at a very large number of points. On December 17, 1913, the *Daily Trade Bulletin* stated that this compilation included, in addition to the Board of Trade visible, stocks at 62 points reporting stocks of 100,000 bushels or over and stocks at "a very large number" of points with stocks between 1,000 and 100,000 bushels each. The *Daily Trade Bulletin* publishes also an annual statement of "stocks in second hands" July 1.[2] This includes the wheat and also the flour, expressed as wheat, reported in their monthly statement for July, and in addition a rough estimate of other stocks in second hands.

The United States Department of Commerce instituted in 1925 a report of stocks of wheat and of flour held by mills. Reports were obtained for June 30 and December 31, 1925, and subsequently quarterly. The aim has been to obtain reports from all merchant mills producing 5,000 or more barrels of flour annually. The mills reporting on the various dates are estimated to have represented between 87 and 91 per cent of the flour output of the country, the later reports being the more complete. As now published, the reports show separately stocks held by mills in country elevators, in public terminal elevators, in private terminal elevators not attached to mills, in transit and bought to arrive, and in mills and mill elevators attached to mills. The stocks held by mills in country elevators and in public terminal elevators are presumably included also in the country mill and elevator figure of the Department of Agriculture and in the visible supply statements, respectively. Wheat bought to arrive may also be included in part in other figures. The item of wheat held in mills and mill elevators attached to mills, usually representing over three-fourths of the total, is presumably not included in any other official statistics. For a calculation of total wheat stocks, the mill stocks figures, though incomplete, should be taken as they stand without attempting to raise them to 100 per cent, since the Department of Agriculture endeavors to cover stocks held by mills under the 5,000-barrel class in its estimate of interior mill and elevator stocks.[3] The Department of Commerce figures have thus far been published as totals for the United States with no classification by cities or regions.

Stocks of wheat on farms July 1 have been estimated by the United States Department of Agriculture for each year since 1895. The *Daily Trade Bulletin* and other private organizations have also published independent estimates of July 1 stocks. These unofficial estimates are usually published on or about July 1, while the official estimate is not released until about the tenth of the month. The chief purpose of the unofficial estimates is to supply advance information on stocks, and they have seldom been regarded as superior in accuracy to the government estimates.

Choice of Data

In selecting from the available data those which will prove most useful for the further study of changes in stocks, a number of considerations need to be borne in mind. Other things being equal, those data should be used which give the most com-

[1] See the *Daily Trade Bulletin*, September 9, 1891.

[2] In recent years this statement has been omitted from the *Daily Trade Bulletin* and published only in the annual Howard Bartels *Red Book*.

[3] A description of the measures being taken to make available a complete and accurate statement of total wheat stocks, quarterly, is contained in the *Agriculture Yearbook, 1926*, pp. 765–67. The Department of Agriculture has not yet been able to carry through the plan of preparing its estimates quarterly.

prehensive statement of stocks, without duplication. It is necessary, however, to have the stocks series consistent throughout, so far as may be possible. If a shift is made in any year from a less complete to a more complete series, there will be an appearance of an increase in stocks which represents merely an increase in the comprehensiveness of the figures. It is desirable also to have the data separately for stocks in the more important classes of positions.

The choice of data for further study and the plan of compilation depend in part upon the purposes for which the data are subsequently to be employed. In the course of the investigation on which this study is based, the data were used in several different combinations, and at one stage the analysis was carried into great detail. The form of the analysis as it appears in the following pages is that which proved simplest and most satisfactory. It involves two related steps: an examination of the degree of correspondence between movements of stocks in the more important different classes of positions, and a derivation of a method of estimating the changes in stocks not covered by the available statistics.

For the purpose of demonstrating the essential facts regarding the correspondence between movements of stocks in the different classes of positions, it is sufficient to have data covering the four broad classes: farm stocks, terminal elevator stocks east of the Rockies, other commercial stocks east of the Rockies, and Pacific Coast commercial stocks. These data suffice also for the subsequent derivation of a method of estimating changes in stocks not covered by the available statistics. For the latter purpose, however, it proves most satisfactory to have two of the stocks series expressed as deviations from "normal."

For farm stocks July 1, there seems to be no ground for preferring any other original series to the official estimates of the United States Department of Agriculture. Since the official estimates are arrived at by obtaining an estimate of the percentage of the previous crop remaining on farms July 1, they are affected by all errors in the production estimates. We have accordingly prepared a revised series of figures for the years 1896–1910 by applying the official estimate of percentage stocks to our revised estimates of production.[1] The resulting figures, together with the official estimates for subsequent years, are shown in Appendix Table II, which presents the basic statistics of stocks employed in this study. The data are shown graphically in Chart 6 (p. 154).

Our designation, "terminal elevator stocks," is equivalent in a general way to the more common term, "visible supply." Neither term is precise without further definition. Obviously there is always room for difference of opinion as to which markets should be classed as terminal markets. There is difference also in practice as to the classes of elevators for which reports of stocks are obtained in the markets generally recognized as terminals. For our purposes the essential requirements are that the statistics cover at least the more important terminal markets and that they be consistent, in the sense of covering stocks at the same group of markets throughout, with no important change during the period in the classes of stocks reported for any market. The existing visible supply statistics seem to satisfy these requirements except for the fact that changes have been made in the number of points for which stocks are reported.

In order to obtain a consistent series of data on terminal elevator stocks east of the Rockies it is necessary to tabulate the stocks for a fixed group of points throughout the period to be covered instead of using the published visible supply totals. Since the object is to obtain a series reflecting the changes in stocks at large terminal markets, figures for the smaller points, of which many are included in the Bradstreet visible, are better omitted. We have accordingly compiled from the *Daily Trade Bulletin* the figures for total stocks at 18 points east of the Rockies on the Saturday nearest July 1 of each year.[2] A few of the

[1] We have used percentages calculated from the published totals for production and stocks rather than the published percentages, which are given to only one decimal place.

[2] The points included are as follows: (1) Baltimore, (2) Boston, (3) Buffalo, (4) Chicago, (5) Detroit, (6) Duluth, (7) Galveston, (8) Indianapolis, (9) Kansas City, (10) Milwaukee, (11) Minneapolis, (12) New Orleans, (13) New York, (14) Peoria, (15) Philadelphia, (16) St. Louis, (17) Toledo, and (18) Canals and Lakes. Stocks afloat at these points, when shown,

points included are no longer important terminal markets and now carry stocks much smaller than those at points which are omitted. Nevertheless, the series is dominated throughout by the stocks at the important terminal markets and includes in all years such a large portion of the public elevator stocks at truly terminal markets that it may be considered accurately representative of such stocks.

The term "outside commercial stocks" is, like "terminal elevator stocks," not precise until defined. Total outside commercial stocks east of the Rockies must logically be regarded, for present purposes, as comprising all commercial stocks of wheat east of the Rockies not included in the terminal elevator stocks series described above. The available statistics, however, cover only a fraction of this total. They are, furthermore, not published in the form of a statement of outside commercials stocks but in the form of totals for all reported (or reported and estimated) commercial stocks, including the terminal elevator stocks.[1] Given such totals, however, the terminal elevator stocks may be subtracted to obtain a series for outside commercial stocks.

Two series are available from which to compile data on outside commercial stocks over an extended period of years: The monthly statement of supplies of the *Daily Trade Bulletin* and the *Daily Market Record* and the annual statement of "stocks in second hands" compiled by the *Daily Trade Bulletin*. In the monthly statement, wheat and flour stocks are shown separately; but in the annual statement of stocks in second hands, the reported stocks of flour shown in the monthly statement are expressed in terms of wheat and included with the reported wheat stocks, and to this combined total is added a rough estimate of unreported stocks, both of wheat and of flour as wheat, expressed always in even millions of bushels. The series which omits flour stocks and includes only wheat stocks actually reported[2] is clearly preferable for present purposes.

It is to be supposed that numerous changes have been made in the list of points represented in the monthly statement of stocks, but the data are not given in sufficient detail to permit correction for these changes in the original compilation. The monthly statement of stocks includes, of course, the wheat at points included in our tabulation of terminal elevator stocks. To obtain a series properly representing outside commercial stocks east of the Rockies, the statistics of terminal stocks previously compiled must be subtracted from the figures given in the *Bulletin's* monthly totals for commercial stocks east of the Rockies.[3] The data thus obtained are shown in column 5 of Appendix Table II.

The *Daily Trade Bulletin* figures for Pacific Coast stocks are more comprehensive than the Bradstreet figures, but when studied separately showed certain peculiarities which led to questioning their consistency. If the *Daily Trade Bulletin* figures be compared with the Pacific Coast stocks reported by *Bradstreet's,* which are published in detail by points, numerous discrepancies appear. The most reasonable conclusion seems to be that the *Daily Trade Bulletin* compilation must have been changed several times to cover an altered list of points, the changes being important enough, relative to the totals, to affect materially the consistency of the series. The Bradstreet figures, though covering a somewhat smaller proportion of the total stocks, seem to furnish the more trustworthy index of year-to-year changes in stocks on the Pacific Coast. In Table 3 (p. 150) are shown the Bradstreet figures, by points and in total, compared with the *Daily Trade Bulletin* totals. The *Bradstreet's* totals are reproduced also in Appendix Table II (column 3) with the other statistics of stocks.

Even the *Bradstreet's* figures do not constitute an entirely consistent series. Between

are included. The Chicago Board of Trade visible supply statement now includes also stocks at Newport News, Fort Worth, Omaha, Sioux City, St. Joseph, and Wichita. At various times in the past it has included also stocks at Albany, Cincinnati, Fort William and Port Arthur, Mississippi River, Montreal, Oswego, St. Paul, and Toronto.

[1] The Department of Agriculture's estimates of country mill and elevator stocks, published since 1919 only, constitute an exception to this statement.

[2] The monthly statement frequently includes some figures described as "partly estimated" or "largely estimated," but these estimates appear to be made merely to fill temporary gaps in the reports and stand on a very different footing from the item of estimated stocks in the second hands statement.

[3] Canadian stocks are of course also excluded. The term "east of the Rockies" is somewhat ambiguous, but is employed in conformity with common usage; stocks in the mountain states are included.

1902 and 1903 some California stocks outside San Francisco were dropped from the series appears serious, and there is, in any event, no possibility of compiling the data

TABLE 3.—PACIFIC COAST WHEAT STOCKS ABOUT JULY 1, AS REPORTED BY *Bradstreet's* AND *Daily Trade Bulletin*, 1892–1927*

(Thousand bushels)

July 1	*Bradstreet's*						*Daily Trade Bulletin*
	Date[a]	San Francisco[b]	Portland	Tacoma	Seattle	Total	Total
1892	2	1,700	500	142	30	2,372	1,475
1893	1	2,170	290	352	30	2,842	3,448
1894	30	7,600	365	284	4	8,253	8,470
1895	29	5,800	488	257	4	6,549	6,251
1896	27	1,267	467	153	40	1,927	2,907
1897	26	856	150	38	68	1,112	1,499
1898	2	1,444	774	440	277	2,935	2,200
1899	1	2,231	600	522	56	3,409	8,920
1900	30	4,217	998	587	101	5,903	11,002
1901	29	2,145	743	336	4	3,228	6,740
1902	28	1,262	884	505	25	2,676	7,157
1903	27	593	818	100	280	1,791	2,281
1904	2	851	430	264	122	1,667	2,151
1905	1	250	332	257	...	839	4,129
1906	30	1,090	689	667	140	2,586	3,330
1907	29	993	334	345	193	1,865	3,290
1908	27	[c]	[c]	[c]	[c]	1,300	2,410
1909	3	530	88	135	100	853	1,597
1910	2	326	665	304	203	1,498	2,512
1911	1	[c]	670	452	358	1,480	2,795
1912	29	[c]	524	727	643	1,894	2,587
1913	28	[c]	942	848	506	2,296	2,927
1914	27	[c]	522	795	330	1,647	1,493
1915	3	[c]	716	524	232	1,472	1,261
1916	1	[c]	307	856	563	1,726	3,130
1917	30	[c]	405	1,277	377	2,059	1,126
1918	29	[c]	5	208	96	309	1,032
1919	28	[c]	599	282	272	1,153	1,449
1920	3	[c]	830	768	495	2,093	4,314
1921	2	[c]	788	191	294	1,273	1,718
1922	1	[c]	[c]	[c]	[c]	1,399	2,913
1923	30	[c]	980	269	466	1,715	3,015
1924	28	[c]	1,140	308	653	2,101	3,901
1925	27	[c]	436	362	585	1,383	1,783
1926	3	[c]	1,979	573	661	3,213	3,663
1927	2	[c]	919	550	503	1,972	2,431

* Compiled from *Bradstreet's* weekly visible supply statement and from the *Daily Trade Bulletin* monthly statement of supplies.

[a] The Bradstreet figures are for Saturdays; dates from 26 to 30 are in June, from 1 to 3 in July. The *Daily Trade Bulletin* figures are totals of reports made for different dates about the first of July in each year.

[b] Prior to 1903, includes stocks at some points outside San Francisco.

[c] No statistics published.

tabulation and after 1910 San Francisco stocks are omitted entirely. Neither of these alterations in the character of the on any better basis. To omit California stocks throughout would indeed give a consistent series, but would practically destroy

its significance for earlier years. Prior to 1903 the California stocks regularly exceeded all the other reported Pacific Coast stocks combined and in a number of years were several times as large as the other stocks.

Consistency of Series

Each of the four series of stocks figures described above has been subjected to a close study after being compiled, to verify, so far as possible, the substantial consistency of each. As noted above, the series for Pacific Coast stocks is not strictly homogeneous. The more important of the two changes in character of the series, that resulting when San Francisco stocks were dropped, can be quite satisfactorily allowed for in the calculation of year-to-year changes in stocks by calculating the change in stocks between 1909 and 1910 on the basis of the data for the three northern ports only.

Other evidence of lack of homogeneity has been discovered only in the series for outside commercial stocks east of the Rockies (obtained, as described above, by subtracting the eastern terminal stocks from the total commercial stocks east of the Rockies, as reported in the monthly statement of the *Daily Trade Bulletin*). The stocks included in this series are presumably all included also in the more comprehensive figures for "country mill and elevator" stocks as estimated by the Department of Agriculture since 1919. It seems reasonable to expect a close correspondence in movement between the Department of Agriculture series and the series derived from the *Daily Trade Bulletin* statistics. Putting both series into the form of percentages of their respective nine-year averages, 1919–27, considerable discrepancies appear, as indicated in the following tabulation.

The discrepancies indicated in the tabulation below may be explained in considerable measure on the assumption that the reports represented in the *Daily Trade Bulletin* series were rendered progressively more complete during the period. This possibility suggests that it is desirable to employ the Department of Agriculture series to measure the changes in outside commercial stocks since 1919. A further reason for employing the latter series is that it is more complete and therefore presumably more representative.

Percentages of 1919–27 Average Stocks

Year	U.S.D.A. series	*D.T.B.* series	Difference
1919.....	70.0	39.5	—30.5
1920.....	132.8	123.1	— 9.7
1921.....	96.7	82.4	—14.3
1922.....	102.4	98.6	— 3.8
1923.....	132.2	159.1	+26.9
1924.....	130.4	106.9	—23.5
1925.....	90.0	86.7	— 3.3
1926.....	81.8	99.5	+17.7
1927.....	63.7[a]	104.2	+40.5

[a] Based on the 1927 estimate for "interior mills and elevators" reduced by 19 per cent to render it roughly comparable with the earlier estimates. (See comment on p. 147.)

Joining Two Series

We undertake therefore to construct an index of outside commercial stocks of wheat based on the *Daily Trade Bulletin* statistics for the period 1896–1918 and on the more comprehensive Department of Agriculture statistics for the period 1919–27.

Probably the simplest method of putting the two series into comparable form so that they may be joined is to express each of the figures in both series as a percentage of the figures for 1919 in the series to which it belongs. Various modifications of this plan involving the same principle might be suggested. Another method is to express each of the figures in both series as a percentage of the average of all the figures in the series to which it belongs. When the two methods are applied and the results compared, with allowance for systematic differences to be expected in the absolute values of the percentages obtained by the two methods, it appears that they are far from consistent. The first method yields figures for the years since 1919 averaging far below those for earlier years, while the second method, of necessity, shows the average for years since 1919 exactly equal to the average for earlier years. On the whole, the results of the latter method appear the more reasonable. We know of no reason for supposing that outside commercial stocks have averaged ma-

terially lower in the years from 1919 to 1927 than for the earlier years. For the entire period from 1896 to 1919 the series derived from the *Daily Trade Bulletin* figures shows a substantially horizontal trend, and the period 1919–27 has included a fairly normal proportion of years in which conditions encouraged the carrying of large stocks on July 1. We have therefore adopted the second method of joining the two series and have derived the "index of eastern outside commercial stocks," designated in Table 4 as "index I," by using the series compiled from the *Daily Trade Bulletin* statistics for the years 1896–1918 and the Department of Agriculture estimates for the years 1919–27, expressing each figure as a percentage of the average for its own series, as indicated in the table.

An Alternative Index

Despite the indications discussed above, that variations in outside commercial stocks since 1919 are reflected more accurately in the Department of Agriculture estimates of country mill and elevator stocks than in the *Daily Trade Bulletin* series, there are also contrary indications. Mr. Howard, of the *Daily Trade Bulletin*, informs us that he is not aware of any substantial increase in the comprehensiveness of their statistics in recent years. While the figures, since 1920, run larger than for years prior to the war, it is quite possible that this is not the consequence of a change in the scope of the data, but a result of a tendency for mills generally to carry larger stocks of wheat into the new crop year than formerly, a practice induced by the increased importance of assuring themselves of adequate supplies of high protein wheat. The reports of wheat stocks at the smaller points of accumulation are obtained chiefly from mills. Though presumably covering all elevator stocks at those points as well as mill stocks, they would be affected by any tendency for mills to carry larger stocks in recent years.

It may be, then, that the Department of Agriculture estimates are weighted more heavily with elevator stocks as compared with mill stocks than are the *Daily Trade Bulletin* figures, and that the combined index derived above is in this respect inconsistent as between its two parts.[1] Though the general considerations suggest that the combined index makes the best use of the available statistics of outside com-

Table 4.—Indexes of Terminal and Outside Commercial Stocks of Wheat East of the Rockies, July 1, 1896–1927

(Per cent of "normal")

July 1	Eastern terminal[a]	Eastern outside commercial	
		Index I[b]	Index II[c]
1896	153.5	116.6	116.6
1897	57.9	81.9	81.9
1898	50.6	28.1	28.1
1899	112.7	142.2	142.2
1900	166.6	127.5	127.5
1901	114.2	108.5	108.5
1902	74.0	86.7	86.7
1903	62.7	77.9	77.9
1904	49.1	92.6	92.6
1905	50.0	68.5	68.5
1906	111.2	112.6	112.6
1907	188.8	166.3	166.3
1908	54.4	83.5	83.5
1909	48.8	56.5	56.5
1910	60.2	99.5	99.5
1911	119.3	112.5	112.5
1912	116.5	93.1	93.1
1913	149.3	106.0	106.0
1914	74.8	102.2	102.2
1915	39.6	50.5	50.5
1916	205.7	186.9	186.9
1917	70.7	32.3	32.3
1918	3.9	15.9	15.9
1919	42.7	70.0	51.5
1920	97.3	132.8	160.3
1921	39.2	96.7	107.3
1922	85.3	102.4	128.5
1923	120.9	132.2	207.2
1924	161.3	130.4	139.3
1925	140.0	90.0	112.9
1926	52.0	81.8	129.7
1927	94.5	63.7	135.8

[a] Percentages of ordinates of the trend shown in Chart 5, based on statistics of stocks shown in Appendix Table II, column 2.

[b] Percentages of average; for the years 1896–1918, based on statistics of stocks shown in Appendix Table II, column 5, using the average for years 1896–1916 as 100 per cent; for the years 1919–27, based on the U.S. Department of Agriculture estimates of country mill and elevator stocks (the 1927 estimate reduced 19 per cent to render it approximately comparable with previous estimates), using the average for all 9 years as 100 per cent.

[c] Based throughout on the statistics shown in Appendix Table II, column 5, using the average for the years 1896–1916 as 100 per cent.

[1] It is of course clearly inconsistent in that for the period 1919–27 it is based on figures which include Pacific Coast stocks, not included previously. This degree of inconsistency is unavoidable and, we believe, entirely negligible in importance.

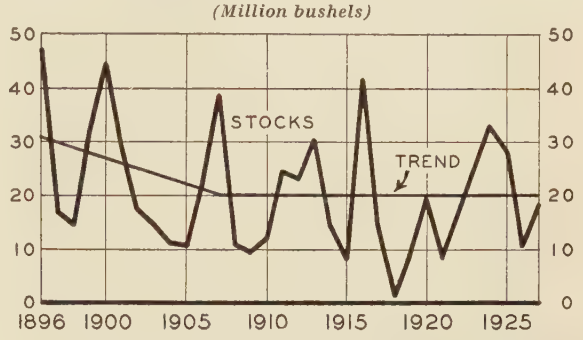
mercial stocks of wheat, it is advisable to have also an alternative index based on the *Daily Trade Bulletin* statistics throughout. For this purpose the 1896–1916 average may be used as 100 per cent, as in the portion of the other index that is based on the *Daily Trade Bulletin* statistics, giving altered figures only for the years since 1919. The data are shown in Table 4 as "index II."

Index of Eastern Terminal Stocks

For part of the subsequent analysis it is distinctly preferable to have measures of changes in stocks in different positions expressed as changes in percentage deviations from normal.[1] In the course of the investigation on which this paper is based, all of the stocks series which showed pronounced secular trends were reduced to indexes in which the ordinates of secular trend represented 100 per cent. For present purposes it is necessary to present only one of these additional indexes, that for eastern terminal stocks. The series for outside commercial stocks show substantially horizontal trends and are entirely satisfactory in the form of the indexes already presented.

The series for eastern terminal stocks shows a marked downward trend from 1896 to about 1907, clearly apparent in Chart 5. It is to be supposed that the downward trend of the earlier years merged gradually into the subsequent horizontal trend. The reliability of any possible method of determining the trend is not sufficient, however, to justify the use of any more complicated method than is involved in obtaining two connected straight lines to describe the trend, as shown in Chart 5.[2]

Chart 5.—Eastern Terminal Wheat Stocks about July 1, 1896–1927*



* Data from Appendix Table II. The figures represent the Chicago Board of Trade visible supply statistics, omitting stocks at Canadian points and at a few other points for which data are available over only part of the period. The trend line forms the basis for calculating "normal" stocks in each year, employed in computing the index of terminal stocks for Table 4.

Removing this trend by throwing the data into the form of percentage deviations from trend, we obtain a series which may be designated as an "index of eastern terminal stocks." The data are shown in Table 4.

V. SIMILARITIES IN MOVEMENTS OF STOCKS

As stated at the close of Section III, the first object of the analysis to follow is to obtain a basis for estimating from the existing statistics the approximate changes in wheat stocks not covered by the statistics available for past years. The belief that reasonably trustworthy estimates can be made rests on the supposition that the changes in the recorded stocks are in each year fairly closely representative of the changes in the unrecorded stocks. This sup-

[1] It is commonly stated that by correlating changes (first differences) in two series the influence of secular trends on the results is eliminated. This is only partly true in most cases. Quite commonly the changes in each of the series tend to be larger during the portions of the period in which the magnitude of the individual values run larger, and vice versa, and this tendency somewhat disturbs the correlation.

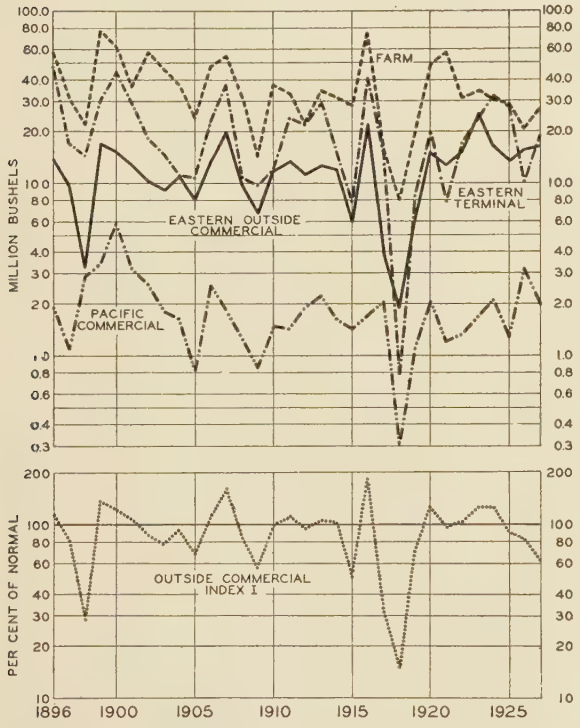
[2] Even so, the problem of obtaining clearly trustworthy results proved extremely difficult. In view of some of the inherent difficulties of the problem, the data were carried back to 1885 to obtain a broader basis for judgment and statistical analysis. The trend first calculated was checked by employing it in the calculation of percentage deviations of the original series from trend, correlating the deviations with a closely related series known from external evidence as well as direct observation to have a substantially horizontal trend, and calculating and charting the residuals. This check proved the trend first calculated to be seriously in error. A second attempt yielded better results, but was still unsatisfactory. The trend shown in Chart 5 represents the final result after a series of such successive approximations.

To give a full account of the method, outlined above, by which the trend was obtained, would require several pages and involve lengthy discussion of points not pertinent to the present study. The extreme care used in determining the trend was in fact not necessary for the purposes of the present study and was exercised only because of requirements of another related investigation. Present requirements would be met by any trend sufficiently accurate to appear satisfactory on a visual study of the chart.

position cannot be investigated directly, but valuable light may be thrown on its validity by determining the degree of similarity in movement of the various classes of stocks covered by the statistics.

The general fact that there is a fair degree of correspondence between the changes in year-end stocks of wheat in different positions is evident from a study of Chart 6. All the curves except that for

CHART 6. — STATISTICAL SERIES REFLECTING CHANGES IN STOCKS OF WHEAT ABOUT JULY 1 IN VARIOUS POSITIONS, 1896–1927*



* Data from Table 4 and Appendix Table II. July 1 stocks of wheat in the various positions show a close agreement in all the major movements, though Pacific Coast commercial stocks show several points of divergence from the other series. The logarithmic scale used for the chart makes any given percentage change appear the same on all the curves, whatever the absolute magnitude of the figures. It appears that Eastern terminal stocks vary somewhat more, relatively, than any of the other classes of stocks.

Pacific Coast commercial stocks show a striking resemblance; years of high stocks in one position are quite uniformly years of high stocks in the other positions, and vice versa; in years in which stocks in one position are increased over the level at the close of the previous year, stocks in the other positions are quite uniformly increased in similar proportion, and vice versa. Still neglecting Pacific Coast stocks, the principal dissimilarities in movement among the curves appear in the peaks reached by eastern terminal stocks in 1900 and in 1924 and the peaks reached by farm stocks in 1902 and in 1921. Farm stocks also failed to decline as much in 1915 as stocks in other positions.

In a comparison of the curve for Pacific Coast commercial stocks with that for eastern terminal stocks, which it appears to resemble most closely, the principal points of discrepancy appear in the sharp increase in Pacific Coast stocks in 1898, the decrease in 1907, and the increases in 1917 and 1926.

Chart 6 has been drawn to a logarithmic scale in order to render the changes in the various curves comparable in terms of percentage changes. A given vertical movement of any curve, in any position on the chart, represents the same percentage change as the same vertical movement of any other curve. Bearing this in mind, it becomes evident that eastern terminal stocks are subject to larger percentage changes than any of the other stocks.[1]

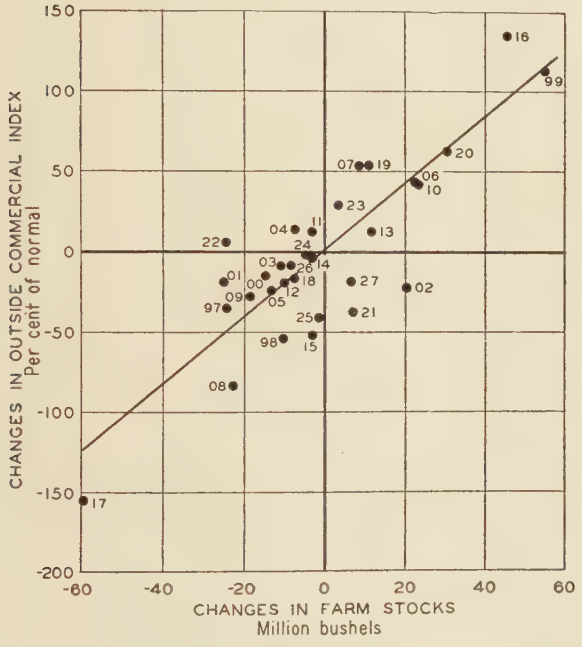
A somewhat clearer indication of the degree of correspondence between changes in the different series of stocks statistics may be obtained from charts designed to show the average relationship, and deviations in individual years from this average relationship. It may be supposed that the unrecorded stocks fall chiefly in the class commonly designated as outside commercial stocks, that is, stocks other than those on farms and in terminal elevators. It is especially interesting, therefore, to note the degree of accuracy with which changes in the existing statistics of outside commercial stocks might have been estimated from changes in the other stocks series.

Chart 7 shows the relationship between changes in the index of outside commercial stocks east of the Rockies and changes in farm stocks, each dot representing the relationship in one year and the heavy diagonal line representing the average relationship. The dot near the extreme lower

[1] The averages of the percentage changes from year to year, neglecting signs, are, for the period 1896–97 to 1926–27: farm stocks, 55 per cent; eastern terminal stocks, 96 per cent; Pacific Coast stocks, 54 per cent; eastern outside commercial stocks, 64 per cent.

left corner of the chart, for example, represents the relation between the changes in the two stocks series between July 1, 1916, and July 1, 1917. Its position indicates that between these dates farm stocks declined nearly 60 million bushels (read on the horizontal scale), and the index of outside commercial stocks declined slightly more than 150 points (read on the vertical scale). The slope of the heavy diagonal line indicates that on the average a change of 10 million bushels in farm stocks is accompanied by a change of 21 points in the index of outside commercial stocks.

CHART 7.—RELATION BETWEEN CHANGES IN THE INDEX OF OUTSIDE COMMERCIAL STOCKS EAST OF THE ROCKIES AND CHANGES IN FARM STOCKS, JULY 1 TO JULY 1, 1896–97 TO 1926–27*



* See note to Chart 9, p. 156.

On the whole, the dots representing the changes in individual years are grouped quite closely about the line of average relationship, showing a close correspondence between changes in the two stocks series and indicating accordingly that changes in the statistics of outside commercial stocks can usually be estimated quite accurately from changes in farm stocks. The most extreme departure from the average relationship appears in 1902, the position of the dot for that year in Chart 7 indicating that the index of outside commercial stocks decreased 20 points while the change in farm stocks would have led to the expectation (based on the line of average relationship) of an increase of over 40 points. Nearly as great a departure from the average relationship occurred in 1921, followed by an approximately equal but opposite departure in 1922. The index of outside commercial stocks, having fallen sharply in 1921, when a slight increase would have been expected from the change in farm stocks, increased only slightly the following year in the face of a sharp decline in farm stocks, thereby re-establishing something like the normal relationship between the absolute values of the two series.

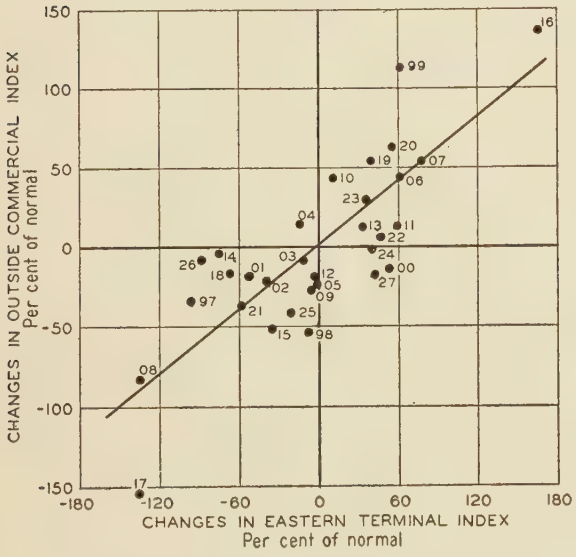
The departures from the average relationship between changes in the index of outside commercial stocks and the changes in farm stocks revealed by Chart 7 may also be noted in Chart 6. The principal advantages gained by placing the data in the form shown in Chart 7 are that the facts may be studied with more precision. The precise nature of the average relationship is clearer, the relative magnitudes of the various departures from the average relationship are more readily compared, and, when several similar charts are compared, the relative closeness of the relationships shown in the different charts is more readily judged.[1]

In Charts 8 and 9 (p. 156) are shown the relation of changes in the index of outside commercial stocks east of the Rockies to the changes in the index of eastern terminal stocks and to the changes in Pacific Coast commercial stocks, respectively. Changes in eastern terminal stocks would have proved a fairly reliable basis for estimating changes in the index of outside commercial stocks in most years. The estimates would have been worst in 1899 and 1900 and rather poor in 1898, 1914, and 1917. On the whole, changes in eastern terminal stocks would have formed about as good a basis for estimating changes in outside commercial stocks as would changes in farm stocks.

[1] The closeness of the relationships may be measured by correlation coefficients, which have been calculated and are shown in footnote 1 on page 168. The correlation coefficients fail to reveal a number of facts, however, that appear clearly in the scatter diagrams; and they contribute nothing of importance for present purposes.

Even changes in Pacific Coast commercial stocks would provide a useful basis for estimating changes in eastern outside commercial stocks in most years. In Chart 9 the line of average relationship shown is not an average for all cases, but is based on

Chart 8.—Relation between Changes in the Index of Outside Commercial Stocks East of the Rockies and Changes in the Index of Eastern Terminal Stocks, July 1 to July 1, 1896–97 to 1926–27*



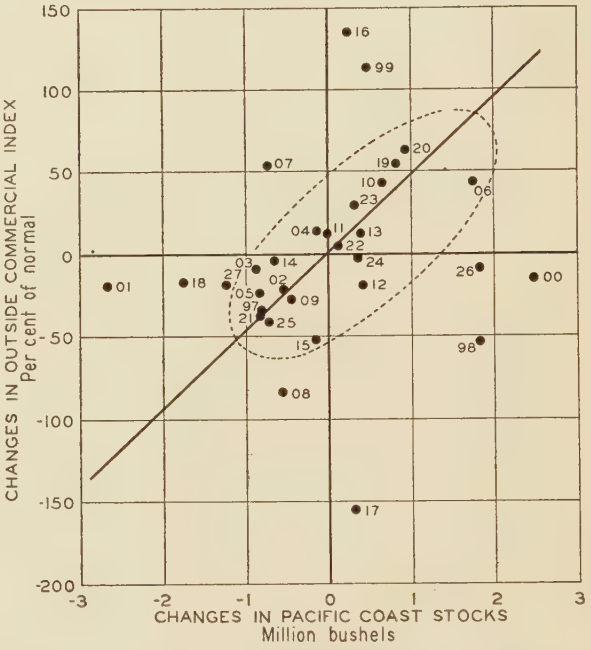
* See note to Chart 9.

the relationship in the "typical" years only, those represented by the dots included within the area bounded by the line of short dashes.[1] This chart shows clearly,

[1] It is unnecessary to discuss here the vexing statistical problem of obtaining an objective basis for discarding observations before calculating a relationship. It is perfectly clear that in this case we have to deal with observations falling in two distinct classes, one group showing a moderate dispersion about the regression line, the other a wide dispersion. The frequency distribution of the residuals approximates that which would be obtained by combining two normal distributions, one with three or four times the dispersion of the other. The frequency distributions of residuals derived from Charts 7–11 inclusive, with this single exception, show approximately normal distributions, as do other similar charts that have been studied. It suffices for present purpose to point out the fact that there exists a typical relationship, to which the variables conform in the majority of cases, but from which there are occasional wide departures, and to indicate roughly what that relationship is. There is no occasion, therefore, for applying refined methods for selecting what we have called the "typical" years.

what is not apparent from a study of the curves in Chart 6, that Pacific Coast commercial stocks and eastern outside commercial stocks move quite closely together in most years, despite the wide divergence of movement in some years. It also indi-

Chart 9.—Relation between Changes in the Index of Outside Commercial Stocks East of the Rockies and Changes in Pacific Coast Commercial Stocks, July 1 to July 1, 1896–97 to 1926–27*



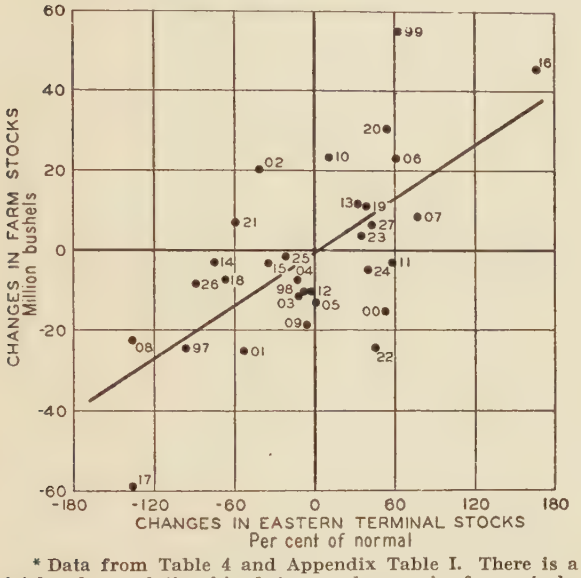
* Data from Table 4 and Appendix Table I. The three charts on this and the previous page reveal somewhat more clearly than Chart 6 (p. 154) the relation between changes in eastern outside commercial stocks and changes in stocks in other positions. The numerals indicate the years, "97" for example representing changes between July 1, 1896, and July 1, 1897. The relations of changes in eastern outside commercial stocks to changes in farm stocks and to changes in eastern terminal stocks are fairly close, while the relation to changes in Pacific Coast commercial stocks, fairly close in most years, breaks down entirely in a few years. The diagonal lines represent the average relationship (in Chart 9, based only on the relationship in the "typical" years—those represented by the dots in the area bounded by the line of short dashes).

cates that wide divergence of movement in one year is quite uniformly followed by an opposite divergence in the following year. In 1916, for example, eastern outside commercial stocks increased sharply while Pacific Coast stocks remained practically stationary; in 1917 eastern outside commercial stocks declined sharply while Pacific Coast stocks again changed but little. Special conditions in 1916 threw Pacific

Coast stocks out of line with stocks elsewhere. Having remained relatively low in 1916, they did not decline in 1917 as did other stocks.

Two other charts of relationships throw significant light on the behavior of stocks in different positions. We have noted that changes in eastern outside commercial stocks may be estimated quite closely either from changes in farm stocks or from changes in terminal stocks. Chart 10, however, shows that changes in farm stocks cannot be estimated at all accurately from changes in terminal stocks. This is somewhat surprising and may appear inconsistent with the facts previously noted, but may readily be explained in general terms. Eastern outside commercial stocks, as represented in the statistics, respond to many of the influences affecting farm stocks and likewise to many of the influences affecting terminal stocks. Apparently, however, there are important influences affecting farm and outside commercial stocks similarly that do not affect terminal stocks, or affect them differently, and likewise important influences affecting terminal and outside commercial stocks similarly that do not affect farm stocks, or affect them differently.

CHART 10.—RELATION BETWEEN CHANGES IN FARM STOCKS AND CHANGES IN THE INDEX OF EASTERN TERMINAL STOCKS, JULY 1 TO JULY 1, 1896–97 TO 1926–27*

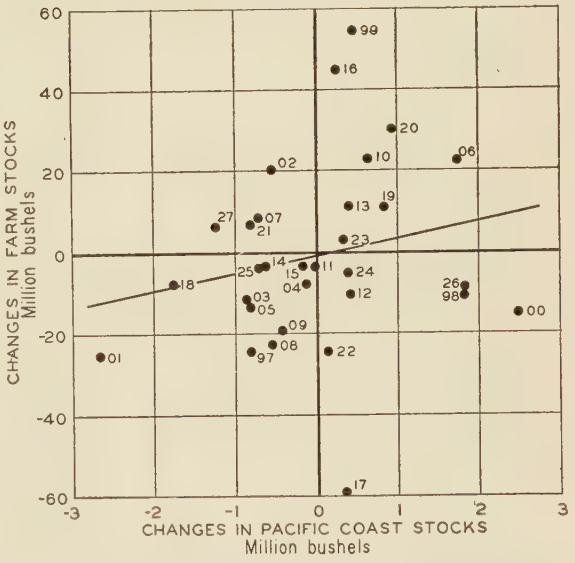


* Data from Table 4 and Appendix Table I. There is a fairly close relationship between changes in farm stocks and changes in eastern terminal stocks, but the relationship is not so close as that between the changes in either of these classes of stocks and the changes in eastern outside commercial stocks (see Chart 7, p. 155, and Chart 8). Eastern outside commercial stocks appear to reflect most clearly the effects of influences common to all three classes of stocks.

This is an important fact to be borne in mind and may well be emphasized by citing a similar situation in which the conditions involved are more readily visualized. Consider the variation in rainfall from year to year in adjacent states. One would expect to be able to estimate Illinois rainfall fairly well from information on rainfall in Iowa and likewise to be able to estimate Illinois rainfall fairly well from information on rainfall in Indiana. But one would not expect to do so well in estimating Indiana rainfall from information on rainfall in Iowa.

Comparing changes in Pacific Coast commercial stocks with changes in farm stocks, as shown in Chart 11, we find again a relationship that is not nearly so close as the relationship between changes in either series and changes in eastern outside com-

CHART 11.—RELATION BETWEEN CHANGES IN FARM STOCKS AND CHANGES IN PACIFIC COAST COMMERCIAL STOCKS, JULY 1 TO JULY 1, 1896–97 TO 1926–27*



* Data from Appendix Table I. There appears to be only a slight relationship between changes in farm stocks and changes in Pacific Coast commercial stocks. Study of Chart 9 indicated that Pacific Coast commercial stocks and eastern outside commercial stocks respond to similar influences in most years and that it was only in occasional years that the unrelated influences were important; as between Pacific Coast commercial stocks and farm stocks, however, the cases in which unrelated influences are important are much more common.

mercial stocks. In studying the relationship between changes in eastern outside commercial stocks and Pacific Coast commercial stocks (Chart 9) it appeared that, while in some years there was no correspondence between the movements of the two classes of stocks, in most years there was a fairly close correspondence. Years showing extreme lack of correspondence seemed to be exceptional. In Chart 11, however, most years appear to be exceptional.

Conclusions

Viewing the evidence of relations between movements of stocks in different classes of positions from the standpoint of its bearing on the problem of estimating the approximate changes in unrecorded stocks, we find that three facts may be set down as significant. First, it is clear that in most years there is a close agreement between the direction and amount of change in stocks in each of the major classes of positions east of the Rockies. Statistics of changes in any class of stocks east of the Rockies seem to furnish a fair basis for estimating changes in any other class of stocks in the same region. Secondly, it appears that the statistics of outside commercial stocks, as compiled, represent a class of stocks less influenced by special conditions, peculiar to itself, than any other class of stocks for which we have examined the statistics, and accordingly that the changes in the series for outside commercial stocks are more broadly representative of changes in stocks in other positions than are any other series. This suggests that the outside commercial series may prove the most useful as a basis for estimating changes in unrecorded stocks. Finally, it appears that each class of stocks shows in some years the influence of conditions that have not affected other classes of stocks or have affected them differently. This being the case, it is to be expected that the unrecorded stocks were affected in some years by conditions the influence of which does not appear in any of the recorded stocks, and that in consequence the estimates of changes in unrecorded stocks, on whatever basis they are made, will be appreciably in error in a few years, although it may be possible to estimate the changes in most years very accurately.

VI. ESTIMATES OF CHANGES IN UNRECORDED STOCKS

Statement of the Problem

The general nature of the next step to be taken is now clear. Since it is evident that the changes in the recorded statistics of stocks east of the Rockies must be quite accurately indicative, in most years, of changes in the unrecorded stocks, the problem of preparing estimates of changes in unrecorded stocks becomes merely a problem of finding which stocks series, or which combination of series, is best adapted to the purpose, and of determining the amount of change in unrecorded stocks, in millions of bushels, usually accompanying a change of one point or of one million bushels in the stocks series to be used as a basis for the estimates. This may appear a difficult task in view of the absence of any data whatever on the magnitude of these unrecorded stocks, except for the last three years. We have, however, for the entire period, figures which indicate the approximate magnitude of the change in the unrecorded stocks in each year. We have noted that when we subtract from the statistics of supplies for each year the available statistics of disposition other than feed and waste, the remainder varies widely from year to year (see Chart 3, p. 144, and discussion in the text on pp. 143–44). If the statistics were otherwise complete, this remainder should represent feed and waste, but on investigation it appeared that the variations in the remainder were to be attributed largely to the influence of changes in stocks that had not been included in the statistics. The remainder is therefore to be regarded as a measure of changes in unrecorded stocks, plus feed and waste. By subtracting from the remainders reasonable estimates of the amount of feed and waste we might obtain a series of figures which would represent more or less accurately the actual changes in unrecorded stocks.

Obviously, the figures for changes in unrecorded stocks thus calculated cannot be expected to be entirely accurate in any

year. They will reflect not only the actual changes in unrecorded stocks, but also the net result of any errors in the data on supplies and disposition employed in the calculation. These errors in the calculated figures for apparent change in unrecorded stocks, however, need have no serious effect on a calculation of the average relation between changes in the statistics of stocks and changes in the unrecorded stocks. It is one of the merits of averages that in them errors tend to cancel out. If we should find, for example, that out of several years in each of which terminal stocks increased 5 million bushels, unrecorded stocks appeared (owing to errors in the data) to have remained constant in some years, to have increased 10 million bushels in other years, but as an average over all such years, to have increased 5 million bushels, then we should feel considerable confidence in the conclusion that actual unrecorded stocks tended quite uniformly to increase 5 million bushels in years in which terminal stocks increased 5 million bushels. On the basis of the facts developed in the foregoing section, we should suppose that in some years the correspondence was far from perfect, but that in most years it was fairly close, and that the average relationship revealed in the study of the imperfect data available furnished a trustworthy statement of the general tendency.[1]

Method of Analysis

The general method of procedure suggested by these considerations requires to be slightly modified in order to deal advantageously with certain technical difficulties.[2] Because there is some question whether the statistics of outside commercial stocks east of the Rockies, as derived from the *Daily Trade Bulletin* data for recent years, are consistent with the similar statistics for earlier years, it is safer not to include the changes in these statistics in the disposition data to be subtracted from the statistics of supplies. The remainder in each year will then represent apparent feed and waste plus changes in both unrecorded stocks and in the recorded outside commercial stocks east of the Rockies. The unrecorded stocks are presumably outside commercial stocks,[3] so that this remainder may be designated as the apparent change in total outside commercial stocks plus "feed and waste." We continue to employ the term "feed and waste" in quotation marks for the reason previously indicated (see pp. 142–43).

Owing to the difficulty of obtaining satisfactory estimates of feed and waste, it proves simpler in the end to deal with these figures for apparent change in outside commercial stocks plus "feed and waste" in the form in which they stand without attempting first to remove the "feed and waste" element. Instead, we derive methods for removing the element of changes in total outside commercial stocks, leaving "feed and waste" as the final residual.

The consequence of these modifications in the method of approach will not be to divert the aim of the study in any sense from the original objective of obtaining a basis for estimating changes in unrecorded stocks. The modifications merely combine with the main objective two subsidiary objectives: to check in some degree the consistency of the available statistics of outside commercial stocks east of the Rockies, and to simplify the calculation of the final "feed and waste" residual.

Simple Relations

To provide the basic data for the analysis, we make a revised calculation of the balance of statistics of supplies and disposition. Instead of using the statistics of changes in stocks employed in the preliminary calculation of "feed and waste" (Table 2, p. 143), we take the revised statistics discussed in Section IV, omitting the relatively small element of statistics of outside commercial stocks east of the Rockies.

[1] A more rigorous demonstration of the fact that errors in the data for the dependent variable need not affect a calculated regression beyond the limits of the fluctuations of sampling is given by Holbrook Working, "The Statistical Determination of Demand Curves," *Quarterly Journal of Economics*, August 1925, XXXIX, 526–39.

[2] In the investigation on which this study is based the data were first handled by the more obvious method, the results demonstrating the need for using the modified method here employed.

[3] On the assumption that the estimates of farm stocks give a substantially complete and accurate statement of actual farm stocks, the unrecorded stocks must be commercial stocks. In line with common usage, they may be designated as "outside" commercial stocks, in the sense of commercial stocks outside the recorded terminal stocks.

The data are shown in Table 5. The figures in the final column, designated "apparent changes in total outside commercial stocks,

TABLE 5.—CALCULATION OF APPARENT CHANGES IN TOTAL OUTSIDE COMMERCIAL STOCKS PLUS "FEED AND WASTE," 1896–97 TO 1926–27

(Thousand bushels)

Year July–June	Supplies[a]	Disappearance other than feed and waste[a]	Change in farm and terminal stocks[a]	Apparent change in total outside commercial stocks plus "feed and waste"[b]
1896-1897	614,134	608,478	—55,108	+ 60,764
1897-1898	687,047	695,609	—11,178	+ 2,616
1898-1899	833,536	708,722	+72,359	+ 52,455
1899-1900	682,517	679,343	+ 679	+ 2,495
1900-1901	639,201	720,940	—43,232	— 38,507
1901-1902	829,019	740,907	+ 8,580	+ 79,532
1902-1903	739,165	715,601	—15,686	+ 39,250
1903-1904	681,512	634,999	—11,694	+ 58,207
1904-1905	584,103	567,569	—14,576	+ 31,110
1905-1906	727,356	617,377	+36,558	+ 73,421
1906-1907	760,316	667,227	+22,309	+ 70,780
1907-1908	637,142	686,308	—49,972	+ 806
1908-1909	654,541	637,284	—20,390	+ 37,647
1909-1910	712,873	624,297	+25,941	+ 62,635
1910-1911	660,410	610,385	+ 8,452	+ 41,573
1911-1912	624,037	625,377	—10,344	+ 9,004
1912-1913	731,065	689,923	+18,598	+ 22,544
1913-1914	765,359	701,468	—18,823	+ 82,714
1914-1915	891,469	903,840	—10,483	— 1,888
1915-1916	1,031,504	809,509	+79,232	+142,763
1916-1917	660,457	774,606	—85,781	— 28,368
1917-1918	665,875	656,040	—22,656	+ 32,491
1918-1919	932,559	829,335	+19,791	+ 83,433
1919-1920	972,759	819,543	+42,155	+111,061
1920-1921	884,031	843,267	— 5,287	+ 46,051
1921-1922	829,371	842,541	—14,999	+ 1,829
1922-1923	885,611	785,793	+10,967	+ 88,851
1923-1924	824,665	717,570	+ 3,550	+103,545
1924-1925	870,597	826,403	— 6,589	+ 50,783
1925-1926	692,012	688,174	—24,166	+ 28,004
1926-1927	844,275	799,060	+13,646	+ 31,569

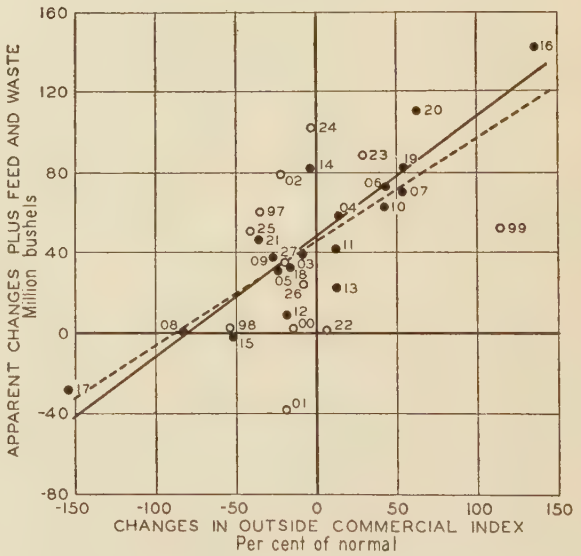
[a] Data from Appendix Table I.
[b] Column 1, minus columns 2 and 3.

plus 'feed and waste'," are composites of three elements. It is the object of the following analysis to separate out each of these three elements, so far as may be possible. The elements are (1) errors in the statistics employed in the calculation, (2) actual feed and waste, and (3) changes in all stocks other than farm stocks (as estimated) and the recorded terminal stocks at 18 points east of the Rockies and three or four points on the Pacific Coast.

First we undertake to separate out the element of changes in stocks. This may readily be done with considerable accuracy on the assumption that any correlation found to exist between the composite series and any series of changes in statistics of stocks must reflect the influence of the element of changes in stocks in the composite series. We know of no reason to expect either of the other elements in the composite series to show a significant correlation with changes in any stocks series.

Charts 12, 13, and 14 show respectively the relation between the composite series and the changes in each of the principal stocks series which might be expected to

CHART 12.—RELATION OF APPARENT CHANGES IN TOTAL OUTSIDE COMMERCIAL STOCKS PLUS "FEED AND WASTE" TO CHANGES IN THE INDEX OF OUTSIDE COMMERCIAL STOCKS EAST OF THE ROCKIES, JULY 1 TO JULY 1, 1896–97 TO 1926–27*



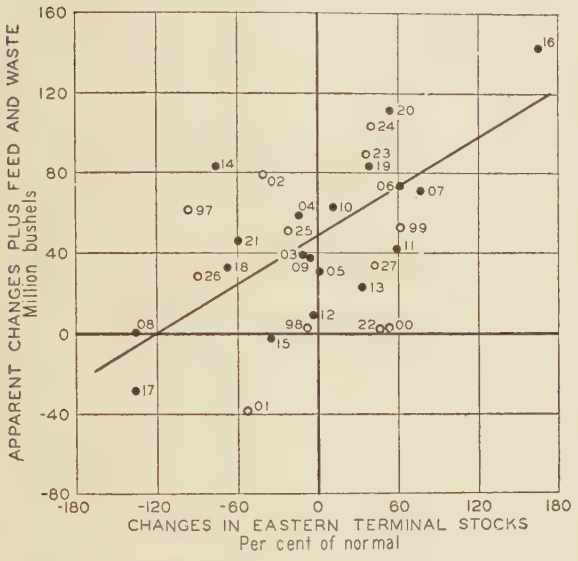
* See note to Chart 14.

be closely related to the element of changes in stocks in the composite series. For reasons that will be made clear shortly, observations for the years 1903–21 are designated by solid dots, observations for other years, by circles. All three of the charts show a fair degree of relationship, especially if only the solid dots be considered, but it is at once apparent that changes in terminal

stocks are less closely related to the element of changes in stocks in the composite series than are changes in either of the other stocks series.

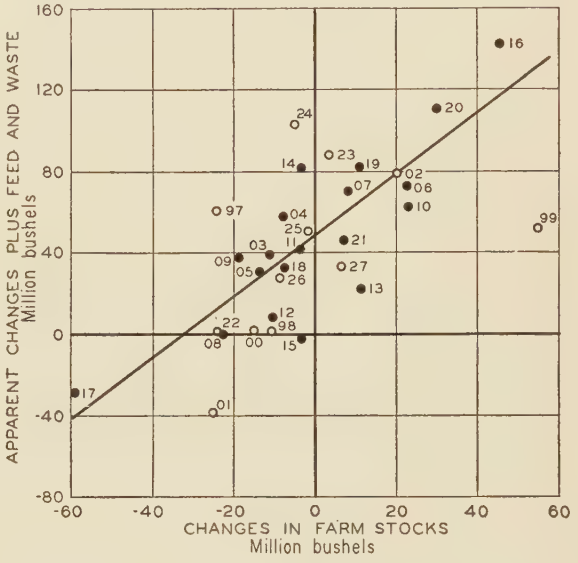
Calculating the average relation between the composite series and the changes in the index of outside commercial stocks east of the Rockies (the dotted diagonal line in Chart 12), we obtain a basis for estimating from the latter series for each year the approximate value of the element of change in stocks in the composite series. We may then subtract these estimates from the figures in the composite series, leaving a residual or "feed and waste" item which represents a combination of actual feed and waste and the effects of all errors in the data of supplies and disposition. The series of values for the "feed and waste" item, thus calculated, are shown graphically in Chart 15 (p. 162).

Chart 13.—Relation of Apparent Changes in Total Outside Commercial Stocks Plus "Feed and Waste" to Changes in the Index of Eastern Terminal Stocks, July 1 to July 1, 1896–97 to 1926–27*



* See note to Chart 14.

Chart 14.—Relation of Apparent Changes in Total Outside Commercial Stocks Plus "Feed and Waste" to Changes in Farm Stocks, July 1 to July 1, 1896–97 to 1926–27*



* Data from Table 4 and Appendix Table I. The apparent change in total outside commercial stocks plus "feed and waste" is a composite of three elements: (1) actual changes in total outside commercial stocks, (2) actual feed and waste, and (3) the effects of errors in the data employed in the computation. The actual changes in total outside commercial stocks are so large and so closely related to the changes in the statistics of stocks in various positions as to result in a fairly close relationship between the composite series and the changes in statistics of stocks. The relationships are closer over the period 1902–3 to 1920–21 (the years represented by the solid dots), in which the element of error in the data appears to be less important.

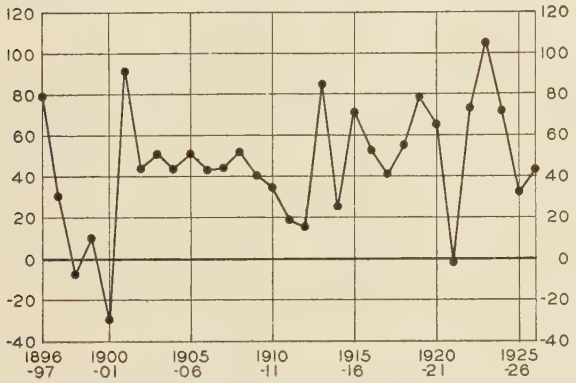
Dealing with Errors in Data

Obviously, the calculated "feed and waste" must be influenced in considerable measure by errors in the data employed in the calculation. In particular, it is not reasonable to suppose that actual feed and waste was as low in the three years 1898–99 to 1900–1901 as is indicated by the data shown in Chart 15, nor is it likely that in the three years 1922–23 to 1924–25 it was as far above that in earlier years as is there indicated. The relatively low figures in the first period and the relatively high figures in the second must arise largely from some inconsistencies in the statistics of supplies and disposition, most probably from inconsistencies in the production estimates. For the earlier period the production estimates employed in the calculation are our revised figures. Our revised estimates are much above the official figures, but on this showing appear to be still too low for the crops of 1898, 1899, and 1900. The evidence here suggests also that our revised estimates for the crops of 1896 and of 1901 (affecting the

observations for 1896–97 and 1901–2 on the chart) are too high, by comparison with later estimates. These indications are all in line with the opinions expressed in connection with the publication of our revised estimates.[1] The evidence in Chart 15 that the

CHART 15.—SECOND PRELIMINARY CALCULATION OF "FEED AND WASTE," FOR CROP YEARS, 1896–97 TO 1926–27*

(Million bushels)



* Data from Table 5 (p. 153). A calculation of the "feed and waste" residual in the disposition tabulation, making use of preliminary estimates of changes in total outside commercial stocks to supplement the statistics of changes in stocks, reveals peculiarities that are difficult to explain on any ground other than that of errors in the data. In particular, it appears that the calculated apparent changes in total outside commercial stocks plus "feed and waste" are affected by unusually large errors prior to 1902–3 and after 1920–21.

production estimates for the crop years 1922–23, 1923–24, and 1924–25 also are out of line with earlier and later estimates may be accepted as sufficient ground for excluding from consideration the data for these years, for the present at least. The negative "feed and waste" figure for 1921–22, though standing alone and possibly the result of a defect in the estimate of change in total outside commercial stocks for that year, is so far out of line with the other figures as to justify omitting the data for this year also in the subsequent calculations of average relationships.

In the nineteen-year period, 1902–3 to 1920–21, inclusive, there are several cases in which the "feed and waste" figure appears extraordinarily high or low compared with other years, but on the whole the figures for these years appear consistent. The isolated extreme values, especially when the deviations from the average are in opposite directions in successive years, as in 1913–14 and 1914–15, especially, may be attributed to defects in the index of outside commercial stocks as a basis for estimating changes in total outside commercial stocks quite as well as to defects in the production estimates. It seems best, therefore, in investigating the relation of changes in the several stocks series to the apparent changes in total outside commercial stocks, to use all the data for the nineteen years, 1902–3 to 1920–21, but to omit the data for earlier and later years. These, however, are retained in the charts for study, but are represented by hollow circles instead of solid dots.

Recomputing the curve of average relationship for Chart 12, we obtain the solid diagonal line. It turns out to deviate only slightly from the dotted line computed from all the data, indicating that the large errors in the data excluded in the second calculation had, as a matter of fact, cancelled out fairly well in the original calculation of the average relationship. The lines of average relationship shown on the two succeeding charts, like the solid line in Chart 12, are computed from the data for the years 1902–3 to 1920–21 only.

Comparing the closeness of the relationships shown in Charts 12, 13, and 14 on the basis of the data for the years 1902–3 to 1920–21, it is more than ever apparent that changes in terminal stocks form the least satisfactory basis for estimating changes in total outside commercial stocks. Changes in the index of outside commercial stocks east of the Rockies appear slightly better for the purpose than changes in farm stocks.[2]

JOINT RELATIONSHIPS

There remains the question of determining whether changes in two or more stocks series taken in combination may not furnish a better basis than changes in any one series alone for estimating changes in total outside commercial stocks. Outside commercial stocks, in the mass, form a hetero-

[1] See especially note 2, p. 258 in "Wheat Acreage and Production in the United States since 1866," WHEAT STUDIES, June 1926, II, No. 7.

[2] The Pearsonian coefficients of correlation are +0.73, +0.83, and +0.90 in the order in which the relationships have been discussed in this paragraph.

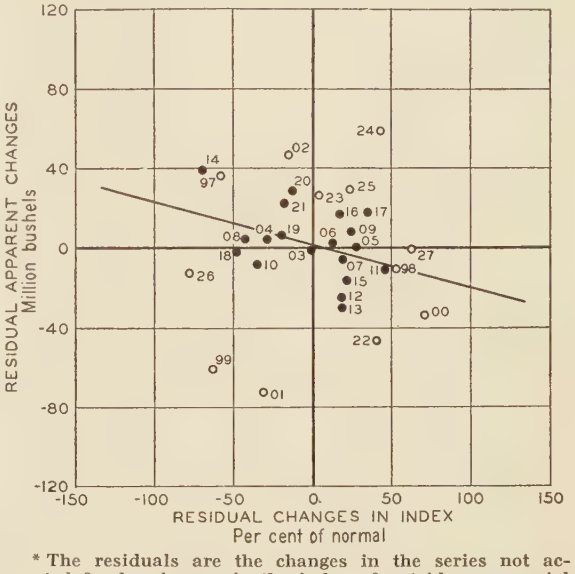
geneous total that may contain various constituent elements, some moving in closest sympathy with one of the classes of stocks covered by the statistics, some with another.

A purely statistical answer is readily obtained from a multiple correlation. The results, taken at face value, indicate that the best estimates of the apparent changes in total outside commercial stocks may be obtained by considering the changes in all of the statistical series together. The improvement in the technical accuracy of the estimates is not great enough, however, to be clearly significant, as judged by statistical tests,[1] and on analysis it appears that the assumptions implied in the "best" formula are not at all reasonable.

Only one joint basis for estimating changes in total outside commercial stocks which seems to deserve serious consideration has been discovered. That one involves the use of the index of outside commercial stocks east of the Rockies and the index of eastern terminal stocks, jointly. The statistical tests indicate that there is fair ground for supposing that the improvement in the estimates is statistically significant[2] and the assumptions involved appear reasonable.[3]

When the statistical evidence is investigated further, however, it appears even less clearly significant than might be expected from the formal statistical measure for probable significance. Chart 16 presents this evidence[4] graphically, the diagonal

CHART 16.—RELATION OF RESIDUAL CHANGES IN INDEX OF EASTERN TERMINAL STOCKS TO RESIDUAL APPARENT CHANGES IN TOTAL OUTSIDE COMMERCIAL STOCKS, 1896–97 TO 1925–26*



* The residuals are the changes in the series not accounted for by changes in the index of outside commercial stocks east of the Rockies. On the basis of the more homogeneous data, indicated by the dots, there is evidence that when terminal stocks increase more than would be expected from the change in the index of outside commercial stocks east of the Rockies, total outside commercial stocks increase less. This is not unreasonable, yet we regard the evidence as inconclusive (see text, p. 164).

[1] The differences between the multiple correlation coefficients and the two best simple correlation coefficients are of the same order of magnitude as the probable errors of the coefficients. The test by comparison of the partial regression coefficients with their computed probable errors seems to be invalidated by the high intercorrelations between the independent variables. In particular, one of the regression coefficients obtained in a multiple correlation appeared almost certainly significant when judged by its computed probable error, but in the light of the known facts was ridiculous.

[2] The partial correlation coefficient is -0.43 with a probable error of ± 0.13. By the usual criteria there appears therefore to be about one chance in eighty that this appearance of a negative partial correlation is "accidental." At a subsequent stage in the study the correlation was recomputed, using index II for the outside commercial stocks, resulting in a somewhat lower partial correlation coefficient, namely, -0.34 ± 0.14. This indicates about one chance in sixteen that the appearance of a negative partial correlation is "accidental."

[3] The regression equation is $A = 45.3 + 0.83C - 0.22T$, where,

A = apparent change in total outside commercial stocks plus "feed and waste," in million bushels,
C = change in index of outside commercial stocks (index I),
T = change in index of eastern terminal stocks.

The negative sign of the coefficient for T is not to be interpreted as meaning that A decreases as T increases, but that A decreases when T increases more than would be expected from the change in C. On this interpretation a negative coefficient appears entirely reasonable. The statistics of outside commercial stocks employed as the basis for C are heavily weighted with stocks at the larger outside points, and it may well be that these tend to move more closely with T than does the general total of outside commercial stocks; that in consequence, the best estimates of A are obtained by including a correction for a tendency of C to move too closely with T.

[4] Using for brevity the notation given in the previous note, this chart shows the correlation of A with T when both are corrected for the values of C on the basis of the calculated regression equations, based on the simple correlations. A simple correlation of the "corrected" values thus obtained gives the partial correlation coefficient $r_{AT.C}$ (using the notation of Yule) and the regression of the corrected values of A on the corrected values of T (represented by the regression line here shown) is the partial regression coefficient $b_{AT.C}$. For a demonstration of these facts, see W. L. Crum, "A Special Application of Partial Correlation," *Quarterly Publications of the American Statistical Association*, December 1921, n.s. No. 136, p. 951. Professor Crum's discussion deals specifically only with the case in which time is one of the independent variables, but is valid for any set of variables.

solid line representing the observed average tendency for apparent changes in total outside commercial stocks to vary inversely with changes in terminal stocks, after making the necessary allowance for changes in the index of outside commercial stocks east of the Rockies.

Neglecting the observations represented by the hollow circles, which have been shown to be probably less trustworthy than the other observations, there still appears no definite concentration of the points about the line of average relationship. On the contrary, such tendency to concentration as does appear is in the neighborhood of the horizontal zero line. There is, therefore, ground for supposing that the general tendency is for the observations to group themselves symmetrically about the horizontal zero line, indicating that there is no relationship, and that the fact that one large positive deviation from this line appears at the left and two large negative deviations at the right, giving a formally measurable relationship, is a pure coincidence. On the whole, we consider it quite as likely as not that the apparent advantage gained by using the index of terminal stocks as part of the basis for estimating changes in total outside commercial stocks is spurious.

We have now derived three separate bases for estimating the changes in total outside commercial stocks of wheat, no one of which is clearly much more trustworthy than any other. We may estimate the changes in total outside commercial stocks from the changes in the index of outside commercial stocks east of the Rockies, from the changes in the estimates of farm stocks, or jointly from the changes in the index of outside commercial and in the index of terminal stocks, all with substantially the same evidence of probable accuracy. In such a case, the most reasonable course to pursue is to derive the estimates on all three bases and see if more cannot be learned from a joint consideration of the three sets of results than from any one by itself.

The Alternative Indexes Again

At this point, however, we must return to the question whether the index of outside commercial stocks east of the Rockies is best used in the form in which it has thus far been employed in the analysis (a composite series, derived from the *Daily Trade Bulletin* statistics for the years 1896–1918 and from the Department of Agriculture estimates of country mill and elevator stocks for subsequent years) or in its alternative form in which it is derived from the *Daily Trade Bulletin* statistics throughout. (See pp. 151–53.) It is now apparent that, so far as it is used at all, this index must form the basis, either alone, or with the index of terminal stocks as a subsidiary factor, for estimates of changes in total outside commercial stocks of wheat. Under these conditions, it is particularly important that the series be consistent throughout, in the sense of reflecting changes in the same classes of stocks. When the series is to be used alone for estimating changes in total outside commercial stocks it is important also that it be derived by the method that will probably render it most representative of changes in total outside commercial stocks.

The fact that the *Daily Trade Bulletin* statistics of outside commercial stocks seem to cover mill stocks at least as adequately as elevator stocks at the smaller points,[1] suggests that they may be more representative of total outside commercial stocks than the Department of Agriculture estimates. In the total outside commercial stocks, mill stocks apparently bulk much larger than elevator stocks (see Chart 4, p. 145). While the *Daily Trade Bulletin* figures cover country rather than city mills, together with country elevators, the country mill element in the figures may reflect very well the changes in city mill stocks. This supposition is supported by a study of statistics for the past three years, during which time city mill stocks statistics are also available.

In the following tabulation, the three series of statistics are expressed as percentages of the figure for 1925 in each series.

	City mill stocks	"Outside commercial" stocks	
		D.T.B.	U.S.D.A.
1925	100	100	100
1926	113	115	91
1927	173	121	71

For these years at least the Department of Agriculture series would furnish a quite

[1] See comment on p. 152 above.

erroneous index of the movement of all outside commercial stocks (including city mill stocks as the largest constituent), while the *Daily Trade Bulletin* series would furnish an index that would be useful in the absence of more complete data.

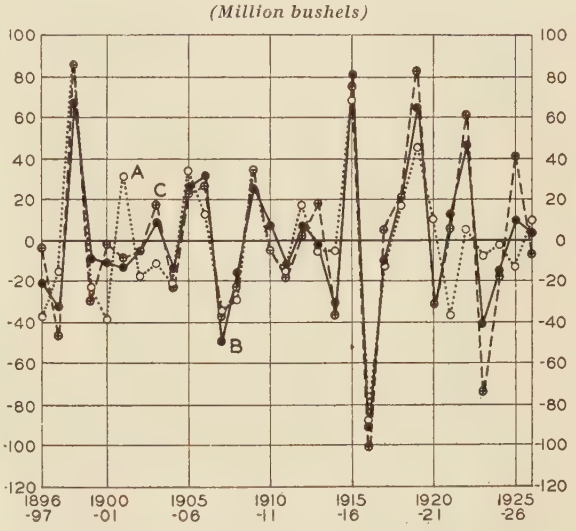
It appears, therefore, that the evidence definitely favors use of this index in the second form, based throughout on the *Daily Trade Bulletin* statistics. It is desirable, therefore, to recalculate the relationships involving changes in the index of outside commercial stocks, using the index in its second form. The second form of the index differs from the first only in the values for 1919 and subsequent years, and since the relationships are determined for the period 1902–3 to 1920–21 only, there are but three values affected, the changes in the index for the crop years 1918–19, 1919–20, and 1920–21. As might be expected, the revised calculations show results differing little from those obtained in the original calculations. The equations of relationship, omitting the constant terms, which represent average "feed and waste," are given in a note to Table 6 (p. 166).

The Estimates

Proceeding with the necessary calculations, we obtain the three sets of estimates of changes in total outside commercial stocks shown in Table 6. Corresponding to each set of estimates of changes in total outside commercial stocks is a different set of figures for "feed and waste," the residuals remaining after the estimates of changes in total outside commercial stocks are subtracted from the composite items for "changes in total outside commercial stocks, plus 'feed and waste.'" These figures are shown in the last 3 columns of Table 6. When these data are put in graphic form, as in Chart 17, showing the alternative estimates of changes in stocks, and Chart 19 (p. 174), showing the alternative series for feed and waste, it appears that the differences are after all seldom large.

Although the broadest basis for forming conclusions is to be found in a joint consideration of the three alternative sets of estimates of changes in total outside commercial stocks and the three corresponding sets of figures for "feed and waste," it is desirable for some purposes to be able to designate one among the three series of estimates of changes in total outside commercial stocks as probably the best. As already noted, the statistical tests failed to yield conclusive proof of superiority of any one of the three sets of estimates over either of the others. They did indicate, however, that

Chart 17.—Alternative Estimates of Changes in Total Outside Commercial Stocks, July 1 to July 1, 1896–97 to 1926–27*



* Data from Table 6. The analysis presented in the text develops three different bases for estimating changes in total outside commercial stocks. The series of estimates designated A is based on the changes in farm stocks; B, on changes in the index of eastern outside commercial stocks; and C, on changes in the index of eastern outside commercial stocks and changes in the index of eastern terminal stocks, jointly. There is little ground for choosing between the three sets of estimates, though series B appears to deserve somewhat greater confidence than the other series.

the estimates based on changes in the index of outside commercial stocks east of the Rockies are probably better than the estimates based on changes in farm stocks. It appears eminently reasonable that this should be the case. As between the estimates based on changes in the index of outside commercial stocks east of the Rockies and the estimates based on a joint consideration of that series and the changes in eastern terminal stocks, the statistical evidence of superiority was ambiguous. In such a case the estimates on the simpler basis are to be preferred as being possibly more trustworthy and certainly easier to interpret. We therefore regard the estimates based on changes in the index of out-

side commercial stocks east of the Rockies as probably superior to either of the other series and represent it by the solid line (B) in Chart 17. This series alone is reproduced in Appendix Table I, and likewise forms the chief basis for the series of estimates of total outside commercial stocks discussed subsequently and shown in Appendix Table II.

For the last two crop years there is available a more reliable basis for obtaining the changes in total outside commercial stocks than that furnished by any of the estimates shown in Table 6. The Department of Agriculture estimates of interior mill and elevator stocks and the Department of Commerce statistics of city mill stocks, together, probably cover most of the outside

TABLE 6.—ALTERNATIVE ESTIMATES OF CHANGES IN TOTAL OUTSIDE COMMERCIAL STOCKS AND CORRESPONDING CALCULATIONS OF "FEED AND WASTE," 1896–97 TO 1926–27

(Million bushels)

Year July 1 to July 1	Estimated change in total outside commercial stocks[a]			Calculated "feed and waste"[b]		
	A	B	C	A	B	C
1896-1897	—36.5	—19.7	— 9.0	+ 97.3	+ 80.5	+ 69.8
1897-1898	—15.5	—30.5	—38.7	+ 18.1	+ 33.1	+ 41.3
1898-1899	+82.6	+64.7	+73.9	— 30.2	— 12.3	— 21.5
1899-1900	—22.5	— 8.3	—20.4	+ 25.0	+ 10.8	+ 22.9
1900-1901	—37.8	—10.8	— 4.9	— .7	— 27.7	— 33.6
1901-1902	+30.3	—12.4	— 9.1	+ 49.2	+ 91.9	+ 88.6
1902-1903	—17.1	— 5.0	— 4.5	+ 56.3	+ 44.2	+ 43.7
1903-1904	—11.7	+ 8.3	+13.3	+ 69.9	+ 49.9	+ 44.9
1904-1905	—20.3	—13.7	—18.1	+ 51.4	+ 44.8	+ 49.2
1905-1906	+33.9	+25.0	+22.0	+ 39.5	+ 48.4	+ 51.4
1906-1907	+12.5	+30.5	+26.2	+ 58.3	+ 40.3	+ 44.6
1907-1908	—33.8	—47.0	—37.8	+ 34.6	+ 47.8	+ 38.6
1908-1909	—28.2	—15.3	—19.1	+ 65.9	+ 53.0	+ 56.8
1909-1910	+34.5	+24.4	+29.9	+ 28.1	+ 38.2	+ 32.7
1910-1911	— 5.1	+ 7.4	— .7	+ 46.7	+ 34.2	+ 42.3
1911-1912	—15.3	—11.0	—13.9	+ 24.3	+ 20.0	+ 22.9
1912-1913	+17.4	+ 7.3	+ 3.8	+ 5.1	+ 15.2	+ 18.7
1913-1914	— 5.0	— 2.2	+10.3	+ 87.7	+ 84.9	+ 72.4
1914-1915	— 5.0	—29.3	—32.2	+ 3.1	+ 27.4	+ 30.3
1915-1916	+68.8	+77.4	+72.1	+ 74.0	+ 65.4	+ 70.7
1916-1917	—88.7	—87.7	—91.1	+ 60.4	+ 59.4	+ 62.8
1917-1918	—11.3	— 9.3	— .4	+ 43.8	+ 41.8	+ 32.9
1918-1919	+16.8	+20.2	+19.6	+ 66.6	+ 63.2	+ 63.8
1919-1920	+45.5	+61.7	+71.2	+ 65.5	+ 49.3	+ 39.8
1920-1921	+10.8	—30.1	—29.2	+ 35.2	+ 76.1	+ 75.2
1921-1922	—36.5	+12.0	+ 7.6	+ 38.3	— 10.2	— 5.8
1922-1923	+ 5.3	+44.7	+52.2	+ 83.6	+ 44.2	+ 36.7
1923-1924	— 7.4	—38.5	—57.5	+111.0	+142.1	+161.1
1924-1925	— 2.4	—15.0	—15.8	+ 53.2	+ 65.8	+ 66.6
1925-1926	—12.6	+ 9.5	+28.0	+ 40.6	+ 18.5	.0
1926-1927	+ 9.6	+ 3.5	— 3.0	+ 22.0	+ 28.1	+ 34.6
Average	25.2	25.2	27.0	....	....	....

[a] Series A calculated from changes in farm stocks (F), using the equation $Y = 1.502\,F$; series B calculated from changes in the index of outside commercial stocks east of the Rockies (C), using the equation $Y = 0.567\,C$; series C calculated from changes in the index of outside commercial stocks east of the Rockies (C) and changes in the index of eastern terminal stocks (T), using the equation $Y = 0.743\,C - 0.176\,T$. These are the equations obtained from the correlations of apparent changes in total outside commercial stocks plus "feed and waste" with the changes in the several stocks series, as discussed in Section VI, with the constant terms omitted.

[b] Obtained by subtracting the corresponding estimates of change in total outside commercial stocks from the apparent change in total outside commercial stocks plus "feed and waste" (Table 5, p. 160).

commercial stocks of wheat in the United States. These figures are available for July 1 of the last three years as follows, in million bushels:

	1925	1926	1927
Interior mill and elevator[a]	31.4	28.5	22.1
City mills[b]	26.7	30.3	46.1
Total	58.1	58.8	68.2

[a] Department of Agriculture estimates, for 1926 and 1927, as published in 1927; for 1925, the original estimate raised 24 per cent.

[b] Department of Commerce figures, omitting stocks reported as held in country elevators and in public terminal elevators.

The changes in total outside commercial stocks indicated by these figures are, for 1925–26, an increase of 0.7 million bushels, and for 1926–27, an increase of 9.4 million bushels. These are the changes shown in column 14 of Appendix Table I for these two crop years.[1]

It is interesting to compare the changes in outside commercial stocks as thus calculated from the fairly complete statistics available for these two years with the estimates shown in Table 6. It is at once apparent that the estimates based on changes in the index of outside commercial stocks (series B) conform better with these figures than the estimates on either of the other bases. If the changes indicated by the above tabulation be taken as accurately representing the facts, the estimates in series A of Table 6 appear to be in error by 13 and 0 million bushels, respectively, the estimates in series B, by 9 and 6 million bushels, and the estimates in series C by 27 and 12 million bushels.

Accuracy of Estimates

The estimates of changes in total outside commercial stocks may be interpreted more intelligently if some criterion can be obtained for judging their probable accuracy. It is, of course, quite impossible to judge whether the estimate for any individual year is close to the truth or far from it. It is quite possible, however, to determine approximately the range within which the majority of the errors will fall.

The errors in the estimates of changes in total outside commercial stocks are undoubtedly similar to the errors that would be made in estimating changes in one of the existing statistical series of stocks from changes in another statistical series. We have in the data discussed in Section V illustrations of the errors that would have occurred in estimating changes in one series from a closely related series and illustrations of the errors that would have occurred in estimating changes in one series from changes in much less closely related series. Which class of situation is involved in the case of the estimates of changes in total outside commercial stocks?

Briefly, it appears that the estimates of changes in total outside commercial stocks must be at least as good as, probably somewhat better than, the best estimates that might have been made of changes in any one of the statistical series from changes in any other. The relative accuracy with which various series may be estimated from other series may conveniently be judged from a comparison of the Pearsonian coefficients of correlation. We noted in Section V, for example, that changes in the index of outside commercial stocks east of the Rockies might be estimated with considerable accuracy from changes in farm stocks, and vice versa. The coefficient of correlation between the two series of changes is +0.81 for the entire period 1896–97 to 1925–26, and +0.91 for the 19-year period, 1902–3 to 1920–21.

We have, of course, no measure of the correlation between changes in total outside commercial stocks and changes in the index of outside commercial stocks east of the Rockies, but we can calculate the coefficient of correlation between the latter series and the series representing apparent changes in total outside commercial stocks plus "feed and waste." This coefficient is +0.90. The series representing apparent changes in total outside commercial stocks plus "feed and waste," as previously noted, is composed of three elements: (1) actual changes in total outside commercial stocks, (2) feed and waste, and (3) the net resultants of all the errors in the data employed in the computation. There is no reason to

[1] In Appendix Table I all of the figures have been shown to thousands of bushels: some of the figures deserve to be shown in this detail, and it has seemed desirable to maintain uniformity despite the fact that others of the figures are probably not significant beyond the millions.

suppose that there is a close correlation between either the second or the third element in this composite series and the changes in the index of outside commercial stocks. In consequence, the observed correlation of +0.90 between the latter series and the composite series must arise largely from the existence of a correlation considerably above +0.90 between the changes in the index of outside commercial stocks and the changes in the one element of the composite series with which it is closely correlated, namely, the changes in total outside commercial stocks. Applying the same reasoning to judge the probable closeness of the relationships involved in the two alternative series of estimates of changes in outside commercial stocks, it appears that the correlations between actual changes in total outside commercial stocks and changes in farm stocks would exceed +0.83, and between actual changes in total outside commercial stocks and changes in the index of outside commercial stocks and in the index of terminal stocks, taken together, would exceed +0.92. As previously indicated, we regard the closeness of the latter relationship as probably partly spurious ("accidental"). There is a similar, though smaller, chance of a spurious element in the other correlations, but on the whole it appears that all three sets of estimates of changes in total outside commercial stocks rest on relationships as close as, or closer than, the relationship between changes in farm stocks and changes in the index of outside commercial stocks east of the Rockies.[1]

[1] The several coefficients of correlation given above and some additional coefficients may be tabulated for convenient reference. In the following tabulation, designations of the coefficients are based on the notation used by Yule, substituting letters for numbers. *A* designates apparent changes in total outside commercial stocks, plus feed and waste; *C*, changes in the index of outside commercial stocks east of the Rockies; *F*, changes in farm stocks; *P*, changes in Pacific Coast stocks; and *T*, changes in the index of eastern terminal stocks. The coefficients of correlation, calculated from the data for the periods indicated, are as follows:

	1902–3 to 1920–21		1902–3 to 1920–21	1896–97 to 1925–26
r_{AC}	0.904	r_{CT}	+0.886	+0.752
r_{AT}	0.733	r_{CF}	+0.909	+0.806
r_{AF}	0.833	r_{CP}	...	+0.628[a]
$r_{A.CT}$	0.916			+0.212

[a] For "typical" years only (see p. 156).

This being the case, a more detailed study of the errors in estimates of changes in one of the statistical series, based on the observed changes in the index of outside commercial stocks east of the Rockies, will throw light on the magnitude of changes in total outside commercial stocks. Table 7 shows in the first column the recorded changes in farm stocks, in the second column the series of estimates of changes in farm stocks, based on the changes in the index of outside commercial stocks east of the Rockies and the observed average rela-

TABLE 7.—RECORDED AND "ESTIMATED" CHANGES IN JULY 1 FARM STOCKS, 1896–97 TO 1926–27

(Million bushels)

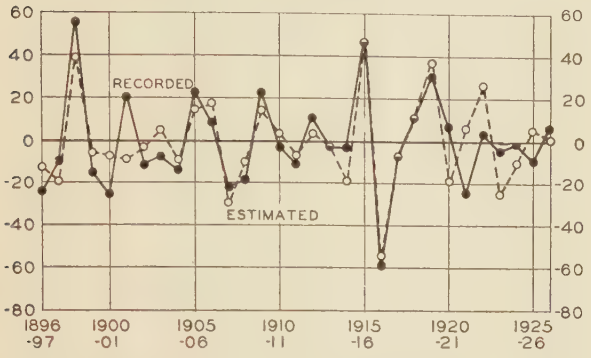
Year	Recorded change[a]	Estimated change[b]	Difference
1896-1897	—24.3	—12.8	+11.5
1897-1898	—10.3	—19.4	— 9.1
1898-1899	+55.0	+38.5	—16.5
1899-1900	—15.0	— 5.9	+ 9.1
1900-1901	—25.2	— 7.4	+17.8
1901-1902	+20.2	— 8.4	—28.6
1902-1903	—11.4	— 3.9	+ 7.5
1903-1904	— 7.8	+ 4.2	+12.0
1904-1905	—13.5	— 9.2	+ 4.3
1905-1906	+22.6	+14.4	— 8.2
1906-1907	+ 8.3	+17.7	+ 9.4
1907-1908	—22.5	—29.4	— 6.9
1908-1909	—18.8	—10.2	+ 8.6
1909-1910	+23.0	+14.0	— 9.0
1910-1911	— 3.4	+ 3.6	+ 7.0
1911-1912	—10.2	— 7.5	+ 2.7
1912-1913	+11.6	+ 3.6	— 8.0
1913-1914	— 3.3	— 2.2	+ 1.1
1914-1915	— 3.3	—18.7	—15.4
1915-1916	+45.8	+46.2	+ .4
1916-1917	—59.1	—54.2	+ 4.9
1917-1918	— 7.5	— 6.5	+ 1.0
1918-1919	+11.2	+11.4	+ .2
1919-1920	+30.3	+36.7	+ 6.4
1920-1921	+ 7.2	—19.1	—26.3
1921-1922	—24.3	+ 6.5	+30.8
1922-1923	+ 3.5	+26.3	+22.8
1923-1924	— 4.9	—24.3	—19.4
1924-1925	— 1.6	—10.0	— 8.4
1925-1926	— 8.4	+ 5.0	+13.4
1926-1927	+ 6.4	+ 1.2	— 5.2
Average	16.8	15.4	10.7

[a] Data from Appendix Table I, column 9.

[b] Calculated from changes in the index of outside commercial stocks east of the Rockies (*C*), using the equation $Y = -0.85 + 0.345C$.

tionship between the two series, and in the third column the difference, in millions of bushels, between the recorded and the estimated values. The recorded and the estimated series are shown graphically in Chart 18. The differences, or errors, aver-

CHART 18.—RECORDED AND "ESTIMATED" CHANGES IN YEAR-END STOCKS OF WHEAT ON FARMS, 1896–97 TO 1926–27*



* Data from Table 7. The probable accuracy of the estimates of changes in total outside commercial stocks (Chart 17) may be judged from a study of the errors in a similar set of estimates of changes in farm stocks. The estimates here shown, based on changes in statistics of outside commerical stocks east of the Rockies, usually agree fairly closely with the recorded changes, but are seriously in error in a few years.

age 10.7 million bushels (neglecting signs). Half of the errors amount to less than 8.6 million bushels, while the largest error is 30.8 bushels.

The errors in the estimates of changes in total outside commercial stocks must be expected to run somewhat larger than these, when expressed in bushels, owing to the fact that the changes involved are larger; the estimated changes in total outside commercial stocks average 64 per cent larger than these estimates of changes in farm stocks. Because the relationship involved is probably somewhat closer, the percentage errors are probably somewhat smaller for the estimates of changes in total outside commercial stocks. The errors in the estimates of changes in total outside commercial stocks, in million bushels, probably average somewhat less, therefore, than 64 per cent above the errors in the estimates of farm stocks. Concretely, the average error in the estimates of changes in total outside commercial stocks is probably somewhat under 17 million bushels and probably less than half of the errors are in excess of 14 million bushels.[1]

It should be noted also that the actual changes in total outside commercial stocks must average larger than the estimated changes, probably by nearly 10 per cent. This results necessarily from the fact that the method employed serves to estimate accurately the influence of part of the factors affecting total outside commercial stocks, but not the influence of all the factors.[2] A similar result is observable in the "estimates" of changes in farm stocks shown in Table 7, which average 9 per cent under the average of the recorded changes.

The general conclusion reached after the study of similarities in movements of stocks (Section V), that changes in one class of stocks may usually be estimated fairly accurately from changes in another class of stocks, but that in a few years large errors are to be expected in such estimates, is pertinent here.

TOTAL OUTSIDE COMMERCIAL STOCKS, JULY 1, 1896–1927

Setting up the disposition table in the form used for this study, it has not been necessary to estimate the actual totals of outside commercial stocks for individual years, but merely the changes from year to year. For some purposes, however, it is important to have a series showing these totals as accurately as possible. Calculations of disposition stated in the usual form require use of the actual figures, and it is frequently more convenient to study the changes in a chart of the actual figures rather than in a chart showing merely the changes from year to year.

[1] The observed errors in the similar estimates of changes in farm stocks throw no light, of course, on the question of which estimates of changes in total outside commercial stocks are most in error or in what direction any particular estimate errs.

[2] Expressed mathematically the estimates have a standard deviation σ_e, while the actual changes have a standard deviation σ_a, which is the result of a combination of the portion of the changes which is accurately estimated and the residual changes, the latter with a standard deviation σ_r. Since the residual changes are necessarily uncorrelated with the estimated changes, $\sigma_a^2 = \sigma_e^2 + \sigma_r^2$. If the coefficient of correlation between the estimates and the actual changes is $+0.90$, $\sigma_e = 0.90\sigma_a$. The arithmetic means of the changes may be expected to show approximately the same relations as the standard deviations of the changes.

If the more comprehensive statistics now available may be assumed to give a substantially complete and accurate statement of outside commercial stocks about July 1, 1927, it is possible to estimate the approximate total outside commercial stocks for earlier years by using the estimated changes to work back from the 1927 total. On further analysis we find some evidence for believing that the existing statistics for stocks of wheat in the United States on July 1, 1927, may be somewhat under the actual total (see p. 177), but we find no trustworthy basis for estimating the amount of the understatement, if such there be. This being the case, the existing statistics of outside commercial stocks July 1, 1927, furnish the best available starting point. Applying the estimated changes in total outside commercial stocks, as shown in Appendix Table I, to work back from the 1927 total derived from the existing statistics[1] we obtain the figures shown in the sixth column of Appendix Table II.

These estimates of total outside commercial stocks are chiefly significant for the year-to-year changes shown, the probable accuracy of which has been discussed above. Whether the absolute values of the figures are approximately accurate or not it seems impossible to determine with certainty.[2] The estimates necessarily show the same trend as the statistics of outside commercial stocks compiled from the *Daily Trade Bulletin* reports: an approximately horizontal trend from 1896 to the war period, followed by an increase to an average level for the last eight years approximately 50 per cent above the pre-war level. It may be that total outside commercial stocks have not in fact averaged in recent years so much higher than in previous years, in which case our estimates for the earlier years are too low.

There is, however, one substantial indication that the level of the estimates for the earlier years is approximately correct. If the general level of the estimates is too low over any considerable portion of the period the changes, when expressed as percentages, will run too large; or if the general level is too high, the changes, expressed in percentages, will run too small. We may reasonably suppose that the average of the percentage changes in total outside commercial stocks must be approximately the same as the average of the percentage changes in the recorded outside commercial stocks, namely about 64 per cent. This supposition is the more reasonable since all the statistics of year-end stocks, other than eastern terminal elevator stocks, show roughly the same average percentage change, the averages ranging from 54 to 64 per cent (see p. 154). Taking account of the fact, demonstrated above, that the estimates of the changes in total outside commercial stocks must average about 10 per cent under the actual changes, it appears, then, that if the level of the estimated totals is correct, they should show an average percentage change of about 58 per cent. This is in fact precisely the average of the year-to-year percentage changes in the estimates of total outside commercial stocks as given in column 6 of Appendix Table II.

VII. ANALYSIS AND CONCLUSIONS

Problems of Interpretation

Having obtained reasonably trustworthy estimates of changes in what we have called total outside commercial stocks of wheat, which are in fact estimates of the changes in total unrecorded stocks of wheat combined with a small element of recorded outside commercial stocks, we have gone as far as it now appears pos-

[1] To obtain the most complete figure for total wheat stocks on July 1, 1927, the Department of Agriculture figure for commercial stocks in the principal markets must be used in place of other visible supply statistics. This figure is 8,689,000 bushels above the total of "terminal stocks" as defined for the purpose of this study and this 8,689,000 bushels must be counted as part of the total "outside commercial" stocks, as here defined. To this are added the reported city mill stocks (omitting stocks held in country elevators and in public terminal elevators) and the Department of Agriculture estimate of stocks of old crop wheat in interior mills and elevators.

[2] If the estimates had been constructed by working back from the 1927 total by using either of the alternative series of estimates of year-to-year changes ("A" or "C" of Table 5, p. 160), the estimates for earlier years would have run much higher.

sible to go toward providing a complete and accurate account of the disposition of American wheat supplies since 1896. We may therefore proceed to the second main problem of this study, that of discovering what important conclusions may be drawn from a study of the data on supplies and disposition.

One important conclusion that must be drawn is already evident: changes in year-end stocks of wheat represent a considerably more important element in the disposition than could have been supposed from an examination of existing statistics of stocks. We may now go farther, however, and determine with some precision the importance of changes in total stocks of wheat relative to other elements in the disposition. A second question deserving investigation is the significance of the figures for "feed and waste," the residual items in the disposition table as we have set it up. These residuals represent a combination of actual feed and waste and the net resultant of all the errors in the data used in the computation. What light do they throw on the changes that have occurred in actual feed and waste and what evidence do they give regarding errors in the data entering into the computation? Finally, we may review such evidence as is available on the question whether with the addition of the Department of Commerce figures on city mill stocks, and with the improved statistics of the Department of Agriculture on commercial stocks at the principal markets and on interior mill and elevator stocks, we may expect to have available for future years substantially complete statements of total year-end stocks of wheat.

Importance of Changes in Stocks

In investigating the importance of changes in total year-end stocks of wheat we may examine first the question of the magnitude of the changes in the unrecorded stocks, as we are now able to estimate them, compared with the changes in the recorded stocks. The compilation of changes in statistics of stocks employed in Table 2 (p. 143) involves some duplication of statistics. To obtain a complete statement of recorded stocks, prior to 1919, without duplication, we have only to add the totals of farm stocks as estimated by the United States Department of Agriculture, and commercial stocks as recorded in the figures compiled by the *Daily Trade Bulletin* and the *Daily Market Record* for their monthly statement of stocks, after deducting from the latter Canadian stocks where they were included.[1] The changes in the statistics of stocks thus compiled are shown in the first column of Table 8 (p. 172). In 1919 the first of a series of improvements in existing statistics of stocks was made. The net result of these extensions of the record of stocks will be considered separately. For the present we are concerned only with the completeness of the record of changes in stocks obtainable from sources available prior to 1919, and for this purpose the figures in Table 8 may well be brought down to date on a comparable basis. In the last three columns of Table 8 are shown our three alternative estimates of changes in unrecorded stocks of wheat.[2]

The principal interest in the figures in Table 8 attaches to the average magnitude of the changes. The changes in the recorded stocks average 30 million bushels over the 31 years, 1896–97 to 1926–27, whereas the changes in the unrecorded stocks appear from these estimates to have averaged between 19 and 21 million bushels. The three sets of estimates are in close agreement as regards the average magni-

[1] The *Daily Trade Bulletin* "stocks in second hands" represent merely the total wheat stocks reported in their "monthly statement," plus reported flour stocks, expressed as wheat, and a small additional item of roughly estimated stocks of wheat and of flour. Only the figures in the "monthly statement" are therefore to be used here, since we are concerned only with stocks of wheat, as such, and can class as "recorded" only such figures on wheat stocks as have a definite statistical basis. Stocks reported in the Chicago visible supply statement are included as a part of the *Daily Trade Bulletin's* "monthly statement," and *Bradstreet's* visible supply statements seem to cover no stocks which can be shown to have been omitted from the *Daily Trade Bulletin's* "monthly statement."

[2] Our estimates of changes in total outside commercial stocks of wheat, as shown in Table 6, represent estimates of a total, part of which is covered by existing statistics of changes in outside commercial stocks. To obtain the strictly unrecorded portion of these estimated changes for this table, we have first added the recorded changes in farm and terminal stocks to the estimates of changes in total outside commercial stocks and then subtracted from these totals the changes in recorded stocks as shown in column 1.

tude of the changes in unrecorded stocks. The changes in unrecorded stocks appear to average two-thirds as large as the changes in the recorded stocks. By inference, the recorded stocks must have covered only about 60 per cent of the actual stocks. Comparison of the averages in Appendix Table II likewise shows the recorded stocks averaging 60 per cent of the estimated total of stocks in all positions.

TABLE 8.—CHANGES IN RECORDED STOCKS AND ESTIMATED CHANGES IN UNRECORDED STOCKS, JULY 1 TO JULY 1, 1896–97 TO 1926–27

(Million bushels)

Year	Recorded stocks[a]	Unrecorded stocks[b]		
		A	B	C
1896-1897	— 59.8	—31.8	—15.0	— 4.3
1897-1898	— 18.7	— 8.0	—23.0	—31.2
1898-1899	+ 92.2	+62.8	+44.9	+54.1
1899-1900	— 1.5	—20.4	— 6.2	—18.3
1900-1901	— 47.1	—33.9	— 6.9	— 1.0
1901-1902	+ 6.9	+32.0	—10.7	— 7.4
1902-1903	— 20.7	—12.1	.0	+ .5
1903-1904	— 9.9	—13.5	+ 6.5	+11.5
1904-1905	— 14.6	—20.3	—13.7	—18.1
1905-1906	+ 39.3	+31.2	+22.3	+19.3
1906-1907	+ 29.4	+ 5.4	+23.4	+19.1
1907-1908	— 60.2	—23.6	—36.8	—27.6
1908-1909	— 24.0	—24.6	—11.7	—15.5
1909-1910	+ 31.3	+29.1	+19.0	+24.5
1910-1911	+ 10.3	— 7.0	+ 5.5	— 2.6
1911-1912	— 13.3	—12.4	— 8.1	—11.0
1912-1913	+ 20.1	+15.9	+ 5.8	+ 2.3
1913-1914	— 20.1	— 3.7	— .9	+11.6
1914-1915	— 16.7	+ 1.2	—23.1	—26.0
1915-1916	+ 97.1	+50.9	+59.5	+54.2
1916-1917	—106.6	—67.9	—66.9	—70.3
1917-1918	— 23.0	—11.0	— 9.0	— .1
1918-1919	+ 23.6	+13.0	+16.4	+15.8
1919-1920	+ 57.1	+30.6	+46.8	+56.3
1920-1921	— 13.4	+18.9	—22.0	—21.1
1921-1922	— 11.4	—40.1	+ 8.4	+ 4.0
1922-1923	+ 20.1	— 3.9	+35.5	+43.0
1923-1924	— 4.1	+ .2	—30.9	—49.9
1924-1925	— 11.1	+ 2.1	—10.5	—11.3
1925-1926	— 22.1	—14.6	+ 7.5	+26.0
1926-1927	+ 14.4	+ 8.9	+ 2.7	— 3.7
Average	30.3	21.0	19.3	21.3

[a] Change in the total obtained by adding farm stocks (Column 1, Appendix Table II), to total recorded commercial stocks compiled from the *Daily Trade Bulletin* (see p. 171).

[b] See footnote 2, p. 171. The three series of estimates of changes in unrecorded stocks correspond to the three series of estimates of changes in total outside commercial stocks as shown in Table 6, p. 166.

The method of preparing the estimates has been such that it is practically impossible that this calculation should overstate the average magnitude of the changes in unrecorded stocks. Rather, they probably understate the average magnitude of the changes in the unrecorded stocks by nearly 10 per cent.[1] It is clear, therefore, that any impressions as to the importance of changes in stocks gathered from a knowledge of the changes shown by the statistics of stocks alone must greatly underrate the importance of changes in stocks in their effect on the disposition.

To judge the true significance of changes in year-end stocks of wheat, the figures must be studied in connection with the other items of supply and disposition. The data are shown graphically in Chart 1 (p. 136). The changes in stocks here shown are totals obtained by adding the estimated changes in total outside commercial stocks, as calculated from the changes in the index of outside commercial stocks east of the Rockies, to the recorded changes in farm and terminal stocks.

The heavy solid line in Chart 1, usually the highest line on the chart, represents the total supplies from production, plus imports. Falling slightly below it in most years is the line of short dashes, representing the total disposition other than "feed and waste." Annual seed requirements are represented by the space under the lowest line on the chart and constitute a relatively small element in the total, showing only minor changes from year to year. Wheat milled in the United States, represented by the next space, constitutes approximately two-thirds to three-fourths of the total disposition, but, with the exception of the period from 1918–19 to 1921–22, shows only slight changes from year to year. Such changes as appear arise chiefly from variations in the quantity of wheat milled for export.

Exports of wheat are represented by the space between the highest light solid line and the line of round dots. This space is cut into by all the double cross-hatched

[1] See the discussion in the text and accompanying footnote on p. 169.

areas, but if attention be fixed on the line of round dots, the varying width of the space can readily be followed. The great variation in the volume of exports is at once apparent, contrasting sharply with the relative stability of the two items of disappearance to which it is added. The line of round dots bounding the upper edge of the space representing the exports, deserves special emphasis again because its height above the base line represents the combined total of all the items of disappearance other than feed and waste.

Changes in stocks are represented by the shaded areas shown above and below the line of total disappearance other than feed and waste, the single cross-hatched areas representing increases in stocks, the double cross-hatched areas representing decreases. The line of short dashes forming the upper boundary of the single cross-hatched areas and the lower boundary of the double cross-hatched areas deserves special emphasis also, for its height above the base line represents the total disposition other than feed and waste out of the current year's crop plus imports. This total disposition is larger than the total disappearance in years in which stocks are increased, while in years in which stocks are decreased the total disappearance exceeds the total disposition.

This line of total disposition other than feed and waste closely parallels, for the most part, the line of total supplies, with a small margin for feed and waste. There are a few exceptional years in which the margin is negative and a few others in which the margin appears extraordinarily large. The fluctuation in this margin may be studied to better advantage from another chart and will be discussed later (p. 174).

It is at once apparent from Chart 1 that the only items in the total disposition capable of much variation under any ordinary circumstances are the exports and the changes in stocks. It is through changes in these items chiefly that variations in the size of the crops must be taken up. Averaging the data for the thirty years from 1896–97 to 1925–26, it appears that the fluctuations in the size of the crop have been absorbed in almost exactly equal amounts by adjustments in these two items of disposition. The facts are conveniently set forth in the following tabulation, the figures being in million bushels.

AVERAGE DEVIATIONS FROM 10-YEAR MOVING AVERAGE

	Production	Exports[a]	Changes in stocks
13 years of large crops....	+80.3	+38.1	+38.1
17 years of small crops....	−63.6	−30.3	−29.3

[a] Including flour expressed in terms of wheat on the basis of the estimated milling ratios for the years in question.

The averages, however, reveal only part of the facts. Variations in the crops as they occurred over this 30-year period were absorbed in approximately equal amounts by variations in exports, and by changes in stocks, but viewing the facts more realistically, it must appear that the relative importance of these two flexible elements in absorbing changes in the size of the crops must depend on the nature of the changes. In prolonged periods of large or small crops such as result from expansion or contraction of acreage, changes in stocks can count for little in absorbing the excess or deficiency; disposition must be adjusted to the supply chiefly by adjustments in exports. The variations in crops which arise from varying weather conditions—high or low yields, and light or heavy winter-killing—are more largely absorbed by changes in stocks.

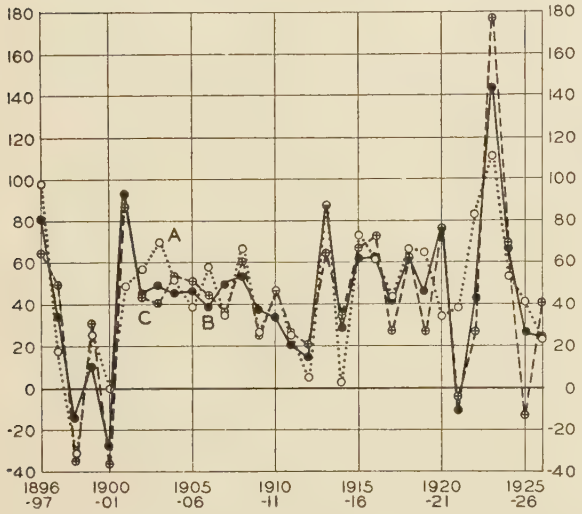
"FEED AND WASTE"

Turning next to the interpretation of the calculated figures for "feed and waste," we may advantageously study as a group the three sets of figures shown in Table 6 (p. 166) and reproduced graphically here in Chart 19 (p. 174). The question of chief interest on which some light may be thrown are: (1) To what extent do variations in the calculated values for "feed and waste" probably arise from errors in the estimates of changes in total outside commercial stocks of wheat? (2) To what extent do variations in the calculated values for "feed and waste" probably arise from errors in other data employed in the computation? And (3) To what extent may the figures be regarded as probably indicative of actual feed and waste?

The second question may best be answered first: some of the extreme values obtained for "feed and waste" must almost certainly arise from errors in data other than the estimates of changes in stocks. The most conspicuous case is the series of three low figures for the years 1898–99 to 1900–1901. The average "feed and waste" figure for these three years, according to each of the three alternative calculations, is less than zero. A single extremely low figure is usually open to possible explanation on the assumption that actual outside commercial stocks may have declined more than the estimated amount (or increased less). To apply this explanation to this series of three low values, however, would involve the assumption of an accumulation of errors in the estimates amounting to some 160 million bushels over the three years (assuming actual feed and waste to have been maintained at the average of the calculated values for the next ten years). Such an assumption is, of course, quite untenable. The chief explanation, at least, of these low figures must lie in errors in other data used in the computation, and among these data only the production estimates seem to offer opportunity for such large errors.

CHART 19.—ALTERNATIVE CALCULATED SERIES FOR "FEED AND WASTE," BY CROP YEARS, 1896–97 TO 1926–27*

(Million bushels)



* Data from Table 6 (p. 166). Each series of estimates of changes in total outside commercial stocks, when employed in the tabulation of supplies and disposition, results in a different series of values for "feed and waste"—the residual item. The three series of calculated values are in agreement in indicating certain errors in the production estimates and also certain probable errors in the estimates of changes in total outside commercial stocks. No calculation of "feed and waste" as the residual item in a tabulation of supplies and disposition appears capable of giving a trustworthy indication of changes in actual feed and waste over this period.

A similar, though less extreme case is presented by the series of low values for "feed and waste" for the four years 1909–10 to 1912–13, inclusive. The average calculated "feed and waste" for these four years is from 18 to 25 million bushels (depending on which set of calculated values is used) under the average for the previous 7 years. To account for this series of low values on the ground of errors in the estimates of changes in total outside commercial stocks would involve the assumption of an accumulation of errors amounting to from 72 to 100 million bushels. We estimate that total outside commercial stocks increased from 35 million bushels on July 1, 1909 to 63 million bushels on July 1, 1913.[1] It is hard to believe that this estimated increase of 28 million bushels should be changed to an estimated decrease of 44 million bushels, as would be called for on the assumption of the smallest accumulation of error capable of furnishing such an explanation of the low "feed and waste" figures. Nor does it appear likely that actual feed and waste was much lower in these years than in previous years. It seems probable that other data employed in the calculation must be at fault in some of these years at least.

For the crop year 1921–22 two of the sets of estimates show negative quantities for "feed and waste," as in the preliminary calculations shown in Chart 15. The third set of estimates, however—that based on changes in farm stocks—shows a reasonable value for the feed and waste in this year. The difference arises from the fact that farm stocks decreased sharply between the beginning and the end of this year, whereas terminal stocks and the recorded outside commercial stocks increased. In the spring of 1921 many farmers held tenaciously to the belief that the drop in prices that had continued through the year would be followed by a reaction, and maintained stocks on farms at high levels at the end of

[1] See Appendix Table II.

the year. During 1921–22 this hope was generally abandoned and farm stocks were reduced accordingly. We know of no reason to suppose that the unrecorded mill and elevator stocks moved with farm stocks under these peculiar conditions, and consider that the evidence indicates strongly that the crop for this year was underestimated.

Among the figures for later years, the only ones which clearly indicate the presence of errors in data other than the estimates of changes in total outside commercial stocks are the figures for 1923–24. The most conservative of the three figures for this year shows "feed and waste" at 111 million bushels. Probably an unusually large amount of wheat was used for feed in this year: an inquiry made by the Department of Agriculture in November 1923 indicated that farmers contemplated feeding some 28 million bushels more wheat than usual in that year.[1] But even allowing for such unusually heavy feeding of wheat, the minimum calculated figure for "feed and waste" is still some 30 million bushels above a reasonable estimate of actual feed and waste (taking as the "usual" feed and waste, the average of the calculated figures for the years 1913–14 to 1920–21) while the alternative figures for the same year are 31 and 50 million bushels higher yet.

The excess of the most conservative figure over a reasonable estimate of actual feed and waste may quite reasonably be attributed to a defective estimate of the change in total outside commercial stocks, but such an explanation for the other values does not accord with such evidence as we have on the probable accuracy of the estimates. There is therefore good reason for suspecting an error in the other data on supplies and disposition for 1923–24. Again suspicion must fall first on the crop estimate.

An answer to the first question stated above may now be attempted: to what extent do variations in the calculated values for "feed and waste" probably arise from errors in the estimates of changes in total outside commercial stocks? Omitting the special cases just discussed, none of the variations, individually, is too large to be accounted for on this ground. Variations in opposite directions in successive years, as in 1913–14 and 1914–15, naturally suggest the presence of such errors.[2] Even more important, the average magnitude of the variations, excluding the exceptional cases already noted, does not exceed a value that might reasonably be expected from errors in the estimates of changes in total outside commercial stocks alone.[3]

Having shown first that certain of the variations in the calculated "feed and waste" figures must apparently be accounted for on the ground of errors in data employed in the calculation, other than the estimated changes in stocks, and second, that the remaining variations may reasonably be accounted for entirely on the ground of errors in the estimates of changes in total outside commercial stocks, there remains nothing which must of necessity be accounted for on the ground of actual variations in feed and waste. The fact is, of course, that actual feed and waste does vary from year to year, probably sufficiently to render the variations a significant factor in the supply and demand situation. To the extent that the variations in actual feed and waste account for the variations in the calculated figures shown in Chart 19, the variations to be accounted for on the ground of errors in the data, including errors in the estimated changes in total outside commercial stocks, are reduced.

It appears probable, however, that the variations in the calculated feed and waste arise so much more largely from errors in the data employed in the calculation than from actual changes in feed and waste that such calculated figures are of little if any value as an index of actual changes in feed and waste. This is probably the most significant conclusion to be drawn from a

[1] The reports showed an intention to feed 11.6 per cent of the crop of 1923 as against a reported "usual" figure of 8.1 per cent. See *Agriculture Yearbook, 1923*, p. 660.

[2] The errors in the estimates of farm stocks shown in Table 7 (p. 168) show a marked tendency to such alternation in direction. More conspicuous cases were noted in the discussion of the relation of changes in Pacific Coast stocks to changes in the index of outside commercial stocks (p. 156).

[3] Assuming that it is not reasonable to expect the estimates of these changes to be more accurate than such estimates of changes in the existing statistical series as might be made from changes in other statistical series, this conclusion follows necessarily from a study of the correlation coefficients shown in the footnote on p. 168.

study of the calculated figures for "feed and waste" and related data.

The data give some basis, however, for judging the amount of variation in actual feed and waste. Though the judgment must be viewed as strictly tentative until direct data on feed and waste over a period of years have been made available, it appears worth while to give quantitative expression to the conclusions suggested by the evidence here assembled. As noted above, the "feed and waste" figures shown in Chart 19 represent the sum of three elements, (1) actual feed and waste, (2) errors in the estimates of change in total outside commercial stocks of wheat, and (3) errors in data on the other items of supply and disposition. It is clear from the moderate degree of variation in the total that the variations in the constituent elements must be smaller than some have supposed them to be. After weighing the various probabilities, it is the opinion of the present writer that the variations in actual feed and waste, in particular, must be smaller than is commonly supposed—specifically, that actual feed and waste can seldom deviate from the average by more than 10 or 15 million bushels.

Such variations, implying a possible change from one year to the next of, say, 25 million bushels, are still by no means negligible. We need more definite information on the amount of variation, and especially we need to know what circumstances are most influential in contributing to large (or small) disappearance as feed and waste. Is the quality of the crop the most important factor, or is it the price of the usual feed grains that is most important?

There is some ground for questioning whether even the general average of the calculated "feed and waste" figures is representative of the general average of actual feed and waste. The calculated figures run most commonly in the neighborhood of 40 to 50 million bushels, representing 5.5 to 7 per cent of an average crop. The reports obtained by the Department of Agriculture in 1923 showed 8.1 per cent of the crop as "usually" fed to livestock in the county where it was grown.[1] Making allowance for additional wheat fed to live stock, for dockage, and for industrial uses not covered in the estimates of wheat milled, it appears that if this estimate is trustworthy, the total of the items of disappearance to be represented under the term "feed and waste" must run considerably above 40 or 50 million bushels. The question whether this is the case or not is of no importance, however, for analysis of the supply and demand situation. For such purposes it is not the absolute volumes of feed and waste that need to be known, but the changes from year to year.

[1] *Agriculture Yearbook, 1923,* p. 660.

Adequacy of Present Statistics

The fact that the statistics of year-end stocks of wheat available prior to 1919 covered only about 60 per cent of the actual total stocks and yet were commonly regarded as substantially complete, makes pertinent the question whether the statistics have even yet been rendered really complete. The best compilation of total year-end stocks of wheat that can now be made is to be obtained by adding together the Department of Agriculture estimates of farm stocks and of interior mill and elevator stocks, the Department of Agriculture statistics of commercial stocks in principal markets (the "United States Department of Agriculture visible supply"), and the Department of Commerce reports of mill stocks of wheat held in mills and mill elevators attached to mills, in private terminal elevators not attached to mills, and in transit and bought to arrive. The tabulation as of about July 1, 1927, is as follows, in thousand bushels:

Farm stocks	27,359
Interior mill and elevator stocks	22,075
U.S.D.A. visible supply	
Domestic wheat	22,083
Foreign wheat in store in bond	7,472
City mill stocks	
In mills and mill elevators	34,149
In other private elevators	1,605
In transit and bought to arrive	10,395
Total	125,138

At first thought it may appear reasonable to expect the results of the foregoing analysis to furnish an answer to the question of the adequacy of the present statistics. Such an analysis, however, is capable of demonstrating only gross inadequacies in the data. If it had indicated that the statistics over

the whole period omitted only 10 per cent of the total outside commercial stocks, for example, the evidence of incompleteness would be regarded as inconclusive.

A more serious limitation of the results of the analysis, for the purpose of judging the adequacy of the existing statistics of stocks, arises from the fact that conditions at present are radically different from conditions over most of the period available for study. It was shown above (p. 170) that the estimates of total outside commercial stocks given in Appendix Table II, column 6, satisfy the most rigorous test we have been able to apply as to the correctness of the general level of the estimates before the war. Since the level of the whole series of estimates is determined by the assumption that the present statistics of stocks are complete, this may be interpreted as a verification of that assumption. Regarding it as a verification, however, implies the further assumption that the great increase in the recorded outside commercial stocks east of the Rockies between the pre-war period and the last few years, is accurately representative of the increase in total outside commercial stocks over the same period. This assumption is not unreasonable, but it may quite possibly be in error. In consequence we must conclude that, while the results of the foregoing analysis indicate that the existing statistics of stocks are substantially complete, no great confidence can be placed in this particular evidence.

To demonstrate clearly the adequacy (or the inadequacy) of the existing statistics of stocks it would be necessary to analyze critically the methods employed in collecting the existing statistics and to devise adequate checks to determine: (1) whether the estimates of "interior mill and elevator stocks" cover all commercial stocks of old wheat not included either in the Department of Agriculture compilation of commercial stocks at principal markets or in the Department of Commerce reports on mill stocks, and (2) whether the estimates of farm stocks are substantially complete and accurate. In our opinion, such an analysis and investigation can most advantageously be made by the Department of Agriculture itself. It would undoubtedly reveal many facts of interest both to the grain trade and to professional statisticians and economists.

For the present we must rely on the judgment of the Department of Agriculture on these points. That judgment seems to be that these estimates of stocks in interior mills and elevators and on farms omit no important body of stocks, but are subject to certain errors, which the Department is endeavoring to remove through improvements in the estimating methods.

In two minor respects the existing statistics are recognized by the Department of Agriculture to be incomplete: they omit wheat stocks held by mills producing over 5,000 barrels of flour annually but not reporting to the Department of Commerce, and they omit stocks in transit except such as are reported by mills.[1] It should be noted also that the statistics of stocks in principal markets (the United States Department of Agriculture visible supply) and of mill stocks are defective for the purpose of disposition tabulations in that the July 1 figures undoubtedly include appreciable quantities of new-crop wheat in some years.

[1] Cf. *Agriculture Yearbook, 1926,* p. 767.

This study has been prepared by Holbrook Working. The directors of the Institute and other members of the staff have contributed information on a number of points. Most of the tabulations and computations have been made by Adelaide M. Hobe, and the charts have been prepared by Douglas L. King

APPENDIX

TABLE I.—SUPPLIES AND DISPOSITION OF WHEAT IN THE UNITED STATES, CROP YEARS 1896–97 TO 1926–27

(Thousand bushels)

Year July–June	Supplies			Disappearance				Apparent change in total stocks plus "feed and waste"
	Production[a]	Imports[b]	Total	Exports[c]	Milled[d]	Seed[e]	Total exclusive of feed and waste	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1896–1897	612,600	1,534	614,134	81,058	451,200	76,220	608,478	+ 5,656
1897–1898	685,000	2,047	687,047	150,105	464,000	81,504	695,609	— 8,562
1898–1899	831,600	1,936	833,536	141,380	483,900	83,442	708,722	+124,814
1899–1900	682,200	317	682,517	102,265	496,300	80,778	679,343	+ 3,174
1900–1901	638,600	601	639,201	132,657	508,600	79,683	720,940	— 81,739
1901–1902	829,900	119	829,019	154,901	508,200	77,806	740,907	+ 88,112
1902–1903	737,900	1,265	739,165	115,485	525,800	74,316	715,601	+ 23,564
1903–1904	681,500	12	681,512	44,281	519,100	71,618	634,999	+ 46,513
1904–1905	581,000	3,103	584,103	5,011	492,200	70,358	567,569	+ 16,534
1905–1906	727,200	156	727,356	35,057	513,300	69,020	617,377	+109,979
1906–1907	759,700	616	760,316	77,225	522,500	67,502	667,227	+ 93,089
1907–1908	636,800	342	637,142	100,753	519,400	66,155	686,308	— 49,166
1908–1909	654,500	41	654,541	67,005	505,300	64,979	637,284	+ 17,257
1909–1910	712,700	173	712,873	46,891	506,700	70,706	624,297	+ 88,576
1910–1911	659,900	510	660,410	23,805	513,400	73,180	610,385	+ 50,025
1911–1912	621,338	2,699	624,037	30,266	522,700	72,411	625,377	— 1,340
1912–1913	730,267	798	731,065	91,796	526,700	71,427	689,923	+ 41,142
1913–1914	763,380	1,979	765,359	93,270	532,600	75,598	701,468	+ 63,891
1914–1915	891,017	452	891,469	259,943	558,900	84,997	903,840	— 12,371
1915–1916	1,025,801	5,703	1,031,504	173,953	557,100	78,456	809,509	+221,995
1916–1917	636,318	24,139	660,457	149,962	547,100	77,544	774,606	—114,149
1917–1918	636,655	29,220	665,875	35,196	530,900	89,944	656,040	+ 9,835
1918–1919	921,438	11,121	932,559	179,109	545,000	105,226	829,335	+103,224
1919–1920	967,979	4,780	972,759	122,580	605,900	91,063	819,543	+153,216
1920–1921	833,027	51,004	884,031	294,115	458,200	90,952	843,267	+ 40,764
1921–1922	814,905	14,466	829,371	208,392	537,900	96,249	842,541	— 13,170
1922–1923	867,598	18,013	885,611	155,180	539,200	91,413	785,793	+ 99,818
1923–1924	797,381	27,284	824,665	78,923	560,500	78,147	717,570	+107,095
1924–1925	864,428	6,169	870,597	195,655	546,600	84,148	826,403	+ 44,194
1925–1926	676,429	15,583	692,012	63,527	542,900	81,747	688,174	+ 3,838
1926–1927	831,040	13,235	844,275	156,397	554,100	88,563	799,060	+ 45,215

[a] Data, 1896–97 to 1910–11, are Food Research Institute revised estimates, from WHEAT STUDIES II, 7, 260; 1911–12 to 1926–27, from *Agriculture Yearbook, 1926*, and *Crops and Markets*.

[b] "General imports" or "imports for consumption" plus "re-exports," whichever was the larger (see pp. 140–41); data from *Monthly Summary of Foreign Commerce of the United States*.

[c] Domestic exports plus re-exports and shipments to possessions (from *Monthly Summary of Foreign Commerce of the United States*) plus shipments of 6,150 bushels to the American Red Cross in 1918–19 (from United States Grain Corporation, *Supplement to Grain and Flour Statistics during the War*, 1920).

[d] Food Research Institute estimates, from WHEAT STUDIES IV, 2, 101.

[e] Calculated at 1.38 bushels per acre sown (see p. 142).

TABLE I.—SUPPLIES AND DISPOSITION OF WHEAT IN THE UNITED STATES, CROP YEARS 1896–97 TO 1926–27 —*Concluded*

(Thousand bushels)

Year July–June	Change in stocks[f]							Total disposition other than feed and waste[g]	Calculated "feed and waste"[h]
	On farms	Terminal			Outside commercial		Total recorded and estimated		
		Eastern	Pacific Coast	Total	Recorded	Total (estimated)			
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
1896-1897	—24,270	—30,023	— 815	—30,838	— 4,136	—19,690	— 74,798	533,680	+ 80,454
1897-1898	—10,304	— 2,697	+1,823	— 874	— 6,428	—30,528	— 41,706	653,903	+ 33,144
1898-1899	+55,001	+16,884	+ 474	+17,358	+13,611	+64,744	+137,103	845,825	— 12,289
1899-1900	—15,017	+13,202	+2,494	+15,696	— 1,751	— 8,341	— 7,662	671,681	+ 10,836
1900-1901	—25,249	—15,308	—2,675	—17,983	— 2,262	—10,781	— 54,013	666,927	— 27,726
1901-1902	+20,194	—11,062	— 552	—11,614	— 2,600	—12,370	— 3,790	737,117	+ 91,902
1902-1903	—11,444	— 3,357	— 885	— 4,242	— 1,056	— 4,993	— 20,679	694,922	+ 44,243
1903-1904	— 7,782	— 3,788	— 124	— 3,912	+ 1,753	+ 8,341	— 3,353	631,646	+ 49,866
1904-1905	—13,463	— 285	— 828	— 1,113	— 2,872	—13,675	— 28,251	539,318	+ 44,785
1905-1906	+22,642	+12,169	+1,747	+13,916	+ 5,256	+25,024	+ 61,582	678,959	+ 48,397
1906-1907	+ 8,296	+14,734	— 721	+14,013	+ 6,413	+30,471	+ 52,780	720,007	+ 40,309
1907-1908	—22,544	—26,863	— 565	—27,428	— 9,884	—46,983	— 96,955	589,353	+ 47,789
1908-1909	—18,809	— 1,134	— 447	— 1,581	— 3,210	—15,321	— 35,711	601,573	+ 52,968
1909-1910	+23,018	+ 2,278	+ 645	+ 2,923	+ 5,125	+24,399	+ 50,340	674,637	+ 38,236
1910-1911	— 3,359	+11,829	— 18	+11,811	+ 1,544	+ 7,377	+ 15,829	626,214	+ 34,196
1911-1912	—10,195	— 563	+ 414	— 149	— 2,303	—11,008	— 21,352	604,025	+ 20,012
1912-1913	+11,639	+ 6,557	+ 402	+ 6,959	+ 1,528	+ 7,320	+ 25,918	715,841	+ 15,224
1913-1914	— 3,279	—14,895	— 649	—15,544	— 449	— 2,156	— 20,979	680,489	+ 84,870
1914-1915	— 3,264	— 7,044	— 175	— 7,219	— 6,162	—29,336	— 39,819	864,021	+ 27,448
1915-1916	+45,759	+33,219	+ 254	+33,473	+16,264	+77,397	+156,629	966,138	+ 65,366
1916-1917	—59,120	—26,994	+ 333	—26,661	—18,439	—87,725	—173,506	601,100	+ 59,357
1917-1918	— 7,548	—13,358	—1,750	—15,108	— 1,958	— 9,306	— 31,962	624,078	+ 41,797
1918-1919	+11,198	+ 7,749	+ 844	+ 8,593	+ 4,248	+20,201	+ 39,992	869,327	+ 63,232
1919-1920	+30,285	+10,930	+ 940	+11,870	+12,984	+61,736	+103,891	923,434	+ 49,325
1920-1921	+ 7,161	—11,628	— 820	—12,448	— 6,322	—30,074	— 35,361	807,906	+ 76,125
1921-1922	—24,348	+ 9,223	+ 126	+ 9,349	+ 2,527	+12,030	— 2,969	839,572	— 10,201
1922-1923	+ 3,535	+ 7,116	+ 316	+ 7,432	+ 9,390	+44,657	+ 55,624	841,417	+ 44,194
1923-1924	— 4,913	+ 8,077	+ 386	+ 8,463	— 8,101	—38,528	— 34,978	682,592	+142,073
1924-1925	— 1,624	— 4,247	— 718	— 4,965	— 3,151	—14,980	— 21,569	804,834	+ 65,763
1925-1926	— 8,384	—17,612	+1,830	—15,782	+ 1,999	+ 734	— 23,432	664,742	+ 27,270
1926-1927	+ 6,386	+ 8,501	—1,241	+ 7,260	+ 730	+ 9,415	+ 23,061	822,121	+ 22,154

[f] Calculated from data in Appendix Table II.
[g] Column 7, plus column 15.
[h] Column 3, minus column 16.

TABLE II.—STOCKS OF WHEAT IN THE UNITED STATES IN VARIOUS POSITIONS ABOUT JULY 1, 1896–1927

(Thousand bushels)

July 1	On farms[a]	In terminal elevators			In outside commercial hands		Total, all positions
		Eastern[b]	Pacific Coast[c]	Total	Recorded[d]	Estimated total[e]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1896	57,161	47,284	1,927	49,211	13,912	68,862	175,234
1897	32,891	17,261	1,112	18,373	9,776	49,172	100,436
1898	22,587	14,564	2,935	17,499	3,348	18,644	58,730
1899	77,588	31,448	3,409	34,857	16,959	83,388	195,833
1900	62,571	44,650	5,903	50,553	15,208	75,047	188,171
1901	37,322	29,342	3,228	32,570	12,946	64,266	134,158
1902	57,516	18,280	2,676	20,956	10,346	51,896	130,368
1903	46,072	14,923	1,791	16,714	9,290	46,903	109,689
1904	38,290	11,135	1,667	12,802	11,043	55,244	106,336
1905	24,827	10,850	839	11,689	8,171	41,569	78,085
1906	47,469	23,019	2,586	25,605	13,427	66,593	139,667
1907	55,765	37,753	1,865	39,618	19,840	97,064	192,447
1908	33,221	10,890	1,300	12,190	9,956	50,081	95,492
1909	14,412	9,756	853	10,609	6,746	34,760	59,781
1910	37,430	12,034	1,498	13,532	11,871	59,159	110,121
1911	34,071	23,863	1,480	25,343	13,415	66,536	125,950
1912	23,876	23,300	1,894	25,194	11,112	55,528	104,598
1913	35,515	29,857	2,296	32,153	12,640	62,848	130,516
1914	32,236	14,962	1,647	16,609	12,191	60,692	109,537
1915	28,972	7,918	1,472	9,390	6,029	31,356	69,718
1916	74,731	41,137	1,726	42,863	22,293	108,753	226,347
1917	15,611	14,143	2,059	16,202	3,854	21,028	52,841
1918	8,063	785	309	1,094	1,896	11,722	20,879
1919	19,261	8,534	1,153	9,687	6,144	31,923	60,871
1920	49,546	19,464	2,093	21,557	19,128	93,659	164,762
1921	56,707	7,836	1,273	9,109	12,806	63,585	129,401
1922	32,359	17,059	1,399	18,458	15,333	75,615	126,432
1923	35,894	24,175	1,715	25,890	24,723	120,272	182,056
1924	30,981	32,252	2,101	34,353	16,622	81,744	147,078
1925	29,357	28,005	1,383	29,388	13,471	66,764	125,509
1926	20,973	10,393	3,213	13,606	15,470	67,498	102,077
1927	27,359	18,894	1,972	20,866	16,200	76,913	125,138
Average 1896–1927	37,520	20,493	1,962	22,454	12,380	61,221	121,196

[a] For the years 1896–1911, based on the Department of Agriculture estimates of percentage stocks and Food Research Institute revised estimates of production (see p. 140); for subsequent years, Department of Agriculture estimates, from *Wheat and Rye Statistics*, p. 37, and *Crops and Markets*.

[b] Chicago Board of Trade "visible supply" at 18 points (see footnote 2, p. 148), compiled from the Chicago *Daily Trade Bulletin*.

[c] Compiled from *Bradstreet's;* see also Table 3, p. 150.

[d] Total reported United States stocks of wheat east of the Rockies, from *Daily Trade Bulletin* monthly statement of "world's available supply of breadstuffs," minus eastern terminal stocks as shown in column 2, above.

[e] Food Research Institute estimates; see pp. 169–70, above.

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OF THE

FOOD RESEARCH INSTITUTE

VOL. IV, NO. 5 MARCH 1928

RYE IN ITS RELATIONS TO WHEAT

ASIDE from wheat, rye is the only cereal from which yeast-leavened loaf bread can be made. Rye is used for bread-making, for feed, and for distillation of alcohol; but only in Europe north of the Alps is production or consumption of large volume. Before the war, the per capita disappearance of rye was about 360 pounds in Germany and only 22 pounds in the United States. Since the war disappearance in both countries has declined, to about 245 pounds in Germany and 17 pounds in the United States. There has been a tendency to abandon rye bread in favor of wheat, though rye is as digestible as wheat except for the bran. Europe has always produced the bulk of the world crop of rye but not of wheat, and has therefore imported much more wheat than rye.

For an equivalent number of calories, the price of wheat usually exceeds the price of rye both in the United States and in Europe. This results largely from consumers' preference for wheat; rye bread has always been the bread of poverty in Europe, and rye tends to be regarded merely as a flavoring medium for wheat in the United States. Demand for rye seems sufficiently inelastic, however, to elevate rye prices above wheat prices in years of marked shortage of rye crops. So long as consumers everywhere continue to prefer wheaten bread and suitable land is available in the world for further expansion of wheat production, and so long as American farmers prefer other grains for feeding stuffs, the prospect for profitable continuous expansion of rye production in the United States is not bright.

STANFORD UNIVERSITY, CALIFORNIA

March 1928

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OF THE

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The Food Research Institute was established at Stanford University in 1921 jointly by the Carnegie Corporation of New York and the Trustees of Leland Stanford Junior University, for research in the production, distribution, and consumption of food.

RYE IN ITS RELATIONS TO WHEAT

In the dietary of most nations the primary foodstuffs, plants and products of plants, exceed secondary foodstuffs, the edible products of animals. Among the primary foodstuffs, cereals are the most important. As a rule, except in the United States and a few other countries exceptionally situated, cereals contribute in terms of calories over half the food supply of a people. The reasons for the predominance of cereals lie both in agriculture and in the characteristics of the grains. The prominent cereals are wheat, rye, corn (maize), barley, oats, the grain sorghums, and rice.

The cereals are primarily carriers of carbohydrate and protein, the fat content being subordinate. Starch forms the outstanding component of all cereals, usually over 70 per cent of the dried weight. The proteins are important, naturally, but particularly so in countries making lesser use, or no use, of animal products. The starch of cereals is the most important fuel-food supporting the body heat and the physical work of domesticated animals and human beings. Since the starches of all cereals yield identical sugar when digested, the grains are directly substitutive. External characteristics may serve to limit substitution to some extent; but for the most part, both for human beings and domesticated animals, any one of the farinaceous cereals may be substituted for any other one. They are substitutive agriculturally to less extent than nutritionally.

The potato deserves to be classed with the cereals because starch is the chief component of the potato. To the extent, therefore, that any cereal represents a source of starch, the potato may be employed as substitute. Agriculturally, also, potatoes are substitutive with cereals over a considerable range.

In each continent are three main groups of grains which, though substitutive, stand somewhat detached from each other in agriculture, trade, and consumption. But though detached, they overlap and their relations are important. The three groups are the bread grains (wheat and rye), the coarse grains (oats, barley, corn, and the grain sorghums), and rice. Rice is widely used in countries bordering on the Mediterranean Sea, in the West Indies, and in Central America, but is a secondary or incidental cereal elsewhere in the Americas, in Africa, in Europe, in Australasia, and in Asiatic Russia. In all of these regions the chief groups of cereals are bread grains and coarse grains. But in Asia (outside of Siberia) and in the East Indies, bread grains, coarse grains, and rice are all prominent as cereal staples in the diet.

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Wheat and rye owe the name bread grain to the familiar fact that yeast-leavened bread is made from their flours. Yeast-leavened loaf breads cannot be made from the flours of corn, barley, oats, and rice, though baked preparations of the biscuit type and quick breads can be made. In mixed breads, coarse grains are often used to stretch the bread grains. But in household and commercial practice, the distinction is fundamental between bread made of flours of gluten-containing bread grains and bread made of meals of gluten-lacking coarse grains.

The relations of wheat and rye to each other are numerous and important. Europe, the largest importer of wheat, is also the largest consumer of rye. North America is a rye-growing continent, with a population of descendants from European stock. A study on rye therefore finds an appropriate place in WHEAT STUDIES. The following statement is not designed to be exhaustive on any point, but is purposed to serve as a general orientation on rye to those who are interested in the agriculture, the food uses, trade practices, and economic relations of wheat.

I. PRODUCTION AND MARKETING OF RYE

Agricultural Relations of Rye

Rye is a more hardy and rugged crop than wheat. It has a wider geographical range, both as to latitude and altitude. In the northern agricultural areas of Europe, Siberia, and in Canada and Alaska, rye matures where wheat cannot make a crop. South of the Equator, rye matures under otherwise favorable conditions in the southernmost parts of South Africa, Tasmania, and Argentina. Rye may successfully be sown in the fall throughout a wheat belt of North America where wheat must be sown in the spring; spring-sown rye, like oats, makes a crop in a belt of considerable width lying north of the spring-wheat belt. At the same time, rye does surprisingly well southward in our temperate zone, in the sub-tropical regions bordering on the Mediterranean Sea and the Gulf of Mexico. Since rye succeeds relatively everywhere that wheat thrives, and over large regions where wheat fails, the potential rye belt of the world is much larger than the potential wheat belt.

It has indeed been suggested that rye became a cultivated crop because it was so hardy a weed-grass that it could not be exterminated and finally became the major crop in some localities. Vavilov has reported[1] that in southwestern Asia wild rye still occurs as a weed in fields of wheat and barley. With increasing altitude, the rye withstands the adverse conditions better than wheat and barley. Long ago wheat and rye were planted together in Russia (and to some extent the practice still persists), the rye tending to predominate with unfavorable climate and on poor soils.

For marginal lands, rye is generally preferred over wheat. The soil requirements of rye are less exacting than those of wheat, and the adaptability is wider. Rye is not so good a crop as wheat for the first breaking of a prairie; but it does better on old and exhausted soils. Rye succeeds on the peaty soils of moors where wheat fails. Rye tolerates acid soils better than wheat; it may be grown on the same land year after year with a less marked decline in yield. Rye does surprisingly well on sandy soils, even if shallow. This explains the widespread distribution of rye over northern Europe; also, rye does well in the sandy soils adjacent to the Mediterranean Sea and widely distributed over our southern states. Larger crops of rye are of course secured on good land than on poor land, but not enough larger to favor the raising of rye if the land is good enough for wheat. Rye is called the "grain of poverty" in Europe as much because it lives on poor soils as because it is the bread of the poor classes.

Rye thrives under a lower mean summer temperature than is necessary for wheat. Rye endures cloudy weather better than wheat, requiring fewer hours of sunshine. The dormant plant stands a lower temperature during the winter, requires less snow cover, tolerates alternate freezing and thawing better; but it is sensitive to excessive moisture near the freezing point, and to freezing at blossom time. Under unfavorable winter conditions, rye makes a half-crop where wheat would fail entirely; under the coolest of summer conditions, rye will produce a part crop where wheat would hardly head at all.

Rye tolerates excessive moisture better than and endures deficient moisture as well as wheat; the newly planted grain makes less demand on subsoil moisture. A rank growth occurs with excessive moisture, with deficient moisture a stunted growth; but under both circumstances, the tendency to head is relatively pronounced. In terms of yield, the outturn is less affected by extremes of moisture than in the case of wheat, and the fluctuations are less. Rye does well in the humid areas of the states adjacent to the Great Lakes and in the subhumid regions of the northern Great Plains area.

Outside of ergot,[2] rye suffers less from parasitic diseases than wheat and is less

[1] *Bulletin of Applied Botany and Plant Breeding*, XXVI, No. 2, 1926.

[2] Ergot is a poison and a drug, as well as a pest of rye. Ergot poisoning, long associated with rye, holds now little more than historical interest except in a few countries of Europe (notably Russia and Spain) where control is still necessary. The condition is due to a parasitic fungus, *Claviceps purpurea*, that infests many grains and grasses but particularly rye. The fungus settles in the blossom of the growing grain, largely replacing the kernels as the head develops and ripening into a dormant stage, the *Sclerotium*

sought out by larger pests. Rust, smut, scab, cinch-bugs, the Hessian fly, the joint worm, and grasshoppers are less feared by growers of rye than by growers of wheat. Under these circumstances, it is sometimes practicable to plant spring rye in the winter-wheat area where spring wheat would stand little chance.

The yield of rye, in pounds per acre, is less than that of wheat under conditions favorable to wheat. But the minimum yield of rye is usually more than the minimum yield of wheat. In northwestern Europe before the war, usual yields were close to 30 bushels per acre; in southern and eastern Europe the usual yields were under 20 bushels; in Russia the yield was not much over 10 bushels per acre. In the Lowlands, France, and Germany, the yield of rye falls substantially below that of wheat. This is not true in Canada and in the United States. But under conditions relatively unfavorable to wheat, rye usually makes a larger yield than wheat. The usual yield of rye is larger under marginal conditions; it is a safer crop, less abandonment is observed, and the average yield therefore better. Since the kernel is smaller, a lower weight of rye is used in seeding than in the case of wheat, which means a relatively larger net yield from the crop. In many regions relatively adapted to both wheat and rye, but not conspicuously favorable to wheat, rye will produce more pounds per acre than wheat; whether more dollars per acre (even though the cost of raising rye is probably somewhat less) is of course another question.

Rye possesses several incidental advantages over wheat, or at least may offer them. When a field of fall-sown wheat offers a too-disappointing yield, it may be used as pasture, plowed for summer fallow, or plowed under for a spring-sown crop. Both wheat and rye, fall-sown, may be cropped in the spring without injury to the later harvest of grain if the condition is good and the cropping not excessive; apart from this, a stand of wheat is not used for fodder except to salvage an abandonment. Practically speaking, wheat is planted only for the purpose of harvesting wheat. But rye is often planted without intention to harvest rye—for pasture, cover crop, ensilage, and hay. Indeed, such use of rye, in rotations, is one of its prime advantages. Rye ripens a week or two earlier than wheat in the same region; it tends to shell out during harvest less than wheat (except Marquis), and demands less prompt attention when ripe for cutting; it sprouts less than wheat in the shock. Rye has a longer straw than wheat, yields more straw to the acre, and therefore furnishes more straw

clavus, which the following spring reinfects the next crop. The intensity of infection and spread of the parasite is favored by high humidity and wind. The parasite in its dormant stage, clumped in the head of the grain-stalk and called by Europeans "the mother-corn," has a waxy consistency and a sweetish taste, which attracts bees and other insects to it, this leading to dissemination of the infection. It may be restrained by the cutting of grasses in infected fields before the dormant stage of the parasite has developed, by adequate preparation of the soil and crop rotation, and by sterilization or cleaning of the seed. The extirpation of the fungus is made impracticable by the fact that the mother-corn brings a high price as raw material for pharmaceutical manufacture of preparations used as drugs. It is not difficult to remove the mother-corn by appropriate cleaning, though traces are likely to remain with the grain and appear in the flour. For the most part, infected rye flour has come from country mills not properly equipped for cleaning the grain, especially in localities where it is customary to grind rye without preliminary cleaning and scouring. European authorities generally regard two-tenths of one per cent of mother-corn in rye flour as the safe limit of tolerance; in some well-studied epidemics of ergot poisoning, the rye flour has been shown to contain over 5 per cent. Large amounts of the spurred rye are revealed in a sticky and semi-fluid consistency of the bread. Chemical, spectroscopic, and microscopic tests are available for application to the flour, but are unsatisfactory when applied to bread. The diagnosis may be confirmed by tests on animals. The prominent symptoms of ergot poisoning are peripheral gangrene (*Ergotismus gangraenosus*) due to the action of one constituent of the ergot on the peripheral blood-vessels, and spastic contractions or convulsions (*Ergotismus convulsivus*) due to the action of another constituent upon the central nervous system. Prior to the Napoleonic Wars, extensive epidemics occurred in various parts of Europe and small isolated epidemics have occurred during the present century. The crop of 1890–91 was the last instance of a generalized appearance of groups of ergot poisoning in Europe, though a sharp localized appearance was noted in Kursk and Tomsk in 1903. A review of the older literature suggests that ergot poisoning was confused with, or associated with, nutritional diseases, since some of the symptoms described, particularly cutaneous lesions, resemble those observed in pellagra. Indeed, some writers regard the historical ergotism as possible of occurrence only in association with inanition.

The parasite of ergot is generally disseminated over our northern states, but the intensity of infection is low. The usual limit of tolerance is three-tenths of one per cent. The routine methods of cleaning rye eliminate all but the very finest particles of ergot, so that American rye flour contains only insignificant traces. Commercially, ergot is more feared in durum wheat than in rye, since the trade standards for semolina are more rigid than for rye flour.

for farm use. Also, the straw has superior qualities for industrial uses, a matter of more importance in Europe than in North America.

Winter rye has definite advantages in rotation in some regions. In the upper Mississippi Valley, when a small grain is used for rotation, the choice often lies between rye planted in the fall and small grains planted in the spring. Being fall-sown and requiring little preparation of the soil (it is usually stubbled in), winter rye offers a better distribution of labor than spring wheat. Both in planting and harvesting, rye distributes farm labor well. Rye, with barley, lends itself well to the demand for concentrates in the northern dairying states. In many sections, therefore, rye has favorable relations in agriculture, despite its lower rating as foodstuff and feeding stuff. Good judges of agriculture believe that progressive farm practice in the United States could make advantageous use of 10 million acres planted to rye if the returns of rye as a cash crop were relatively remunerative. Raising rye is agriculturally advantageous, but selling the crop tends to be economically disadvantageous.

Characteristics of Rye as Grain

According to the official grain standards of the United States Department of Agriculture, "Rye shall be any grain which, before removal of dockage, consists of 50 per cent or more of rye, and when free from dockage contains not more than 10 per cent of cereal grain of a kind or kinds other than rye." Four grades of rye are established (Nos. 1, 2, 3, 4), weighing respectively 56, 54, 52, and 49 pounds minimum per Winchester bushel, and containing respectively not over 13, 14, 15, and 16 per cent of moisture. Grades 1 to 3 inclusive must be cool and of natural odor, i.e., sound; No. 4 rye must be cool, but may be musty or slightly sour. The four grades are permitted to contain, respectively, not over 2, 4, 7, and 15 per cent of damaged kernels, of which those with heat damage may not exceed respectively 0.1, 0.2, 0.5, and 3.0 per cent. The total foreign material other than dockage permitted is limited respectively to 3, 6, 10 and 10 per cent of the whole, of which the foreign matter other than wheat is limited respectively to 1, 2, 4, and 6 per cent. There is nothing in the grading of rye corresponding to vitreous kernels in the case of wheat. Ryes circulating in the channels of trade, and especially those passing into export, are likely to bear regional designations. Thus, No. 2 Western is probably the most common grade of rye exported.

The ryes of the United States incline to be of one type, though improved strains have been developed at home and introduced from abroad. Improved ryes are Dakold, Rosen, North Dakota No. 9, Advance, and Swedish. Before the war our production of rye was so small that agronomists felt little incentive to improve the grain. Since the war there has been scanty time, and little occasion, for improvement. Naturally, our mills select the best rye for grinding, according to high American standards for rye flour. Therefore, just as in the case of wheat, the poorer ryes go abroad. Under these circumstances, it is not surprising that Europeans have rated American ryes rather low in the scale.

In Europe, on the other hand, rye has received more attention from cerealists and improved strains have been adapted to particular regions. The ryes of Europe are of two types, depending largely on soil and climate. The one type is soft, usually with high moisture content, often tough even when sound, and low in protein. Such are the ryes usually grown on the poorer sandy soils of northern Europe. Other areas, especially in Russia and the Danubian region but including parts of Germany and the other western and southern European countries, produce a hard rye, of low moisture content and fairly high protein content. The soft rye meets the needs of distilleries and feeding yards; the hard rye is adapted to the manufacture of flour. The two are commonly referred to as bread rye and feed rye—analogous to malt barley and feed barley. Before the war, international trade consisted largely of bread rye; since the war Europe has imported all kinds of rye.

All commercial rye is more or less dark-colored. Plant breeders in rye countries have long sought to produce a white rye, and every so often the evolution of a white rye is reported. Such a rye has never reached commercial production. There are, however, improved varieties of rye having less color than common kinds.

Rye is a seed covered with a coat (also called testa or spermoderm) under which lies a thin layer called the nuclear layer, with the embryo (the germ of the young rye plant) lodged at one end while the bulk of the interior is occupied by the endosperm. In milling the operation is to free the endosperm more or less completely from the germ, the nuclear layer, and the husk or coat.

The kernel of rye is usually rather smaller than the kernel of wheat and of a less plump contour. It has a relatively thicker coat and larger embryo; the endosperm is smaller. This corresponds to a difference in the proportions of coat, germ, and endosperm; the endosperm of wheat comprises a larger proportion of the kernel than that of rye, and therefore wheat yields more flour than rye. The endosperm of rye amounts usually to less than 75 per cent of the weight of the grain, and to make a bran-free rye flour the extraction must usually be below 68 per cent. The endosperm of wheat comprises around 82 per cent of the weight of the grain, and a bran-free flour can usually be secured with an extraction of 74 per cent. In general, therefore, wheat can be extracted to 74 per cent and rye to 68 per cent with production of comparable straight flours. In Germany a rye flour of 70 per cent extraction is regarded as comparable in fiber content with a wheat flour of 77 per cent extraction. These relative positions tend to be maintained upward and downward. Wheat is therefore naturally a higher-priced grain partly because it holds more higher-priced flour and less lower-priced offal.

Rye and wheat of comparable water content differ sensibly in composition. Both are poor in fat, but rye has still less fat than wheat. The starch content of rye is somewhat higher than that of wheat. It is in the protein, however, that the important difference is found. Wheat contains much more protein than rye. The best ryes rarely contain over two-thirds as much protein as the best wheats; the poorest wheats do not contain as little protein as the poorest ryes. In the soft type of rye the protein content may run as low as 6 per cent; the hardest may yield over 10 per cent. Comparable German flours of rye and wheat carry respectively from 8.5 to 11 and from 11 to 14 per cent of protein, from which the protein contents of rye and wheat as grain may be adjudged. American ryes run on the average considerably lower in protein than the ryes of Europe.

The caloric content of rye tends to run slightly less than that of comparable wheat. This is not enough to make any difference in judging ryes for the manufacture of flour. The higher starch content of rye is an advantage in the manufacture of alcohol; but on this point rye is to be compared not with wheat, which is rarely used for distillation, but with corn, potato, and molasses.

Acreage and Production of Rye

The group of bread grains contains numerous wheats, and rye. The wheats belong to the genus *Triticum.* Many wheats are newer or older hybrids. Classed under wheat are several varieties of emmer and spelt. Polish wheat and durum wheat are regarded as mutations of emmer; the common bread wheats (*Triticum vulgare*) are believed to have been derived from spelt. Rye is *Secale cereale;* it is not closely related to the wheats. The grains of Polish wheat sometimes resemble those of rye and have been erroneously classed as such. Wheat and rye have been crossed, both naturally and experimentally, wheat being the mother plant. The hybrids are commonly sterile, though in a few instances fertile descendants have been propagated over a number of generations. Both spring and winter rye exist, but winter rye is much the more common.

Wheat was grown in pre-Christian times by Aryans and Chinese. It must have been brought into northern and western Europe in the earliest centuries of the Christian era. Rye is supposed to have been cultivated from, or was a mutation of, *Secale montanum,* a grass indigenous to the foothills around the Mediterranean Sea. We have no records of rye grain in pre-Christian times. It became distributed during the medieval period and after the Renaissance was more prominent than wheat. Indeed, rye was the predominating bread grain up to the nineteenth century. In this sense, considering the development of modern agriculture, rye may be said to have been the older bread grain. Prior to the nineteenth

century, rye was prominent in Great Britain and widespread over Spain, France, and Italy, the Danubian regions, and European Russia. Rye and corn were planted earlier than wheat by English settlers in Massachusetts, by Dutch settlers in New York, and by Swedish settlers in Delaware; it was planted early in Maryland, Virginia, and Georgia. In early colonial times rye was the staple flour of New England. The prominence of wheat is largely a matter of the last century. The outstanding wheat regions of southern Russia, North America, South America, and Australia are mostly of relatively recent origin. The wheats that now make up the largest part of the international trade in wheat are less than a half-century old. Wheat culture has been vastly improved, while that of rye has lagged; in consequence, wheat has outstripped rye.

To furnish a background, the reported acreage and production of wheat and rye in the world since 1909 are shown in Table 1. The data are incomplete because of the absence of information for China and Asia Minor; and Russian figures are probably not trustworthy for pre-war years.[1] According to these incomplete figures, world rye production in terms of bushels runs, on the average, slightly larger than two-fifths of world wheat production. Rye production would appear relatively smaller if data on both crops were available for China and Asia Minor, since these regions are known to be large producers of wheat but small producers of rye.

As will be pointed out later, the present acreages planted to wheat and rye do not represent the potential acreages. No emphasis is to be laid upon the absolute figures; it is quite as much the relative positions that interest us. When world acreages of bread grains are viewed by geographical subdivisions[2] it is observed that the distribution of wheat acreage is conspicuously world-wide, while rye is prominent only in Europe and European Russia. Indeed, for many years Russia and Germany have probably furnished over 70 per cent of the rye of the world. The relative position with respect to acreage has not been significantly modified since the war;

TABLE 1.—ESTIMATED WORLD WHEAT AND RYE ACREAGE AND PRODUCTION, 1909–27*

Year	Acreage (million acres)		Production (million bushels)	
	Wheat	Rye	Wheat	Rye
1909	...	...	3,665	1,772
1910	...	...	3,613	1,689
1911	...	...	3,606	1,593
1912	...	...	3,894	1,909
1913	...	...	4,126	1,900
Average	278	109	3,781	1,773
1914	...	...	3,668	1,631
1915	...	...	4,324	1,597
1916	...	...	3,265	1,430
1917	...	...	3,196	1,158
1918	...	...	2,911[a]	586[a]
1919	...	...	2,821[a]	682[a]
Average	...	...	3,364[a]	1,181[a]
1920	...	...	3,268	983
1921	262	91	3,374	1,254
1922	249	93	3,468	1,432
1923	258	102	3,800	1,474
1924	270	110	3,523	1,421
1925	288	116	4,102	1,828
1926	300	114	4,231	1,709
1927	310	116	4,289	1,855
Average	277	106	3,757	1,494

* Data of U.S. Department of Agriculture. Dots (...) indicate that comparable estimates are not available. Estimates include all Russian territory reporting for years named, but exclude China and Asia Minor.

[a] Excluding Russia in 1918 and 1919.

but, on account of the relatively greater concentration of rye production in Europe, the smaller post-war yields per acre both of rye and wheat in Europe have resulted in a decline in world rye production not apparent in world wheat production.

RYE PRODUCTION IN EUROPE

The following rough figures, in million bushels, may be taken to represent the normal crops of wheat and rye in the several European countries under usual conditions of weather, our purpose being not to illustrate total bread grain production but rather to contrast production of wheat with that of rye.[3] Russia, Germany, Poland, Czecho-

[1] Soviet authorities assert that the 1909–13 average of wheat production based upon official data is too low by about 150 million bushels, while rye production is some 175 million too low.

[2] See Appendix Tables I–IV, which show rye acreage and production by countries.

[3] These figures are not averages, but merely rough approximations to representative figures of production.

Slovakia, Austria, Scandinavia, Finland, the East Baltic States, Belgium, and Holland produce more rye than wheat. The preponderance of rye is partly the expression of soils and climate, but partly the result

Country	Wheat	Rye
Russia	700	900
Germany	100	300
Italy	200	7
France	330	40
Spain and Portugal	150	30
Poland	50	225
Czecho-Slovakia	35	50
Austria	10	20
Hungary	70	30
Jugo-Slavia	70	10
Bulgaria	40	8
Roumania	100	10
Scandinavia	20	35
Finland and East Baltic	5	50
Belgium	15	20
Holland	5	15

of established crop rotations and of industrial uses for rye. It is hard to believe that the acreage planted to wheat and rye respectively in the European countries expresses for consumers the most economical division of land and labor when viewed in the light of import requirements and of the respective prices of wheat and rye. It is probably as much an agricultural heritage as an economical arrangement.

In Europe north of the latitude of the Alps, and in northern Russia, the acreage of rye is determined by soil, climate, and existing systems of crop rotation. Wheat is planted by preference whenever possible. Where the prospects for wheat are poor, then rye, oats, or barley is planted in accordance with customary rotations. In Europe south of the latitude of the Alps, and in southern Russia, the acreage of rye is limited by consideration of relative returns. In effect, rye is planted only to the extent dictated by customary crop rotation and on soils not locally adapted to wheat.

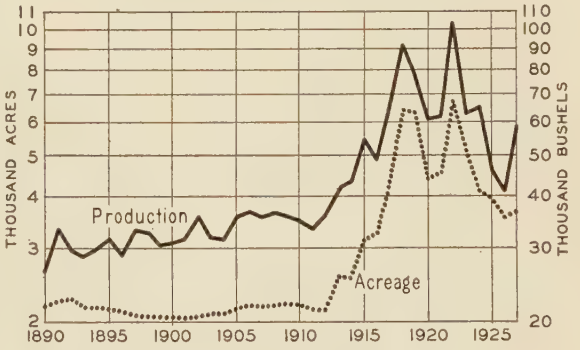
Rye grows more or less everywhere in European Russia, from the tundras to the steppes. In the so-called "northern soils," with the short summer, rye is with oats the chief crop; flax, barley, and wheat are variously prominent in different regions. In the so-called "southern soils," wheat is more prominent than rye, at least in certain regions; barley and oats are also commonly raised, and corn to the southward. Of the cultivated area of Russia before the war, about two-thirds was planted to cereals. Of the total acreage planted to cereals, over a third was in rye (both spring and winter), about a fourth in wheat, a fifth in oats, and a tenth in barley. Ordinarily, rye was cultivated in Russia with primitive methods, and it often fell heir to soils exhausted by wheat and flax. Quite consistently the yields per acre were low. Siberia has large regions available, under climatic difficulties, for growing wheat and rye. Wheat has been preferred; and it is worthy of note that in Siberia have been developed quick-maturing strains of wheat that seem to stand drought and cold almost as well as rye.

Rye Production in the United States

Chart 1 presents the data on acreage and production of rye in the United States from 1890 to 1927.[1] The acreage reported was harvested acreage; we do not possess reports of abandonment of rye acreage. If the figures for planted acreage were available, these would diverge from harvested acreage more than in the case of wheat. The reason would not be larger abandonment on account of winterkilling, but larger use for pasture, cover crop, ensilage, and hay.

Chart 1.—Acreage and Production of Rye in the United States, 1890–1927*

(Logarithmic vertical scale)



* Official data. See Appendix Table II.

From 1890 to the outbreak of the war the rye acreage of the United States varied

[1] See Appendix Table II for detailed annual data, including yield per acre.

little, never below 2 million acres and never above 2.3 million acres until 1913. The per capita acreage declined over the period. The yield per acre rose gradually from about 12 bushels per acre to about 16.

The war provided to rye growers an extraordinary incentive for expansion. As indicated in the chart, the acreage rose progressively to 6.4 million acres in 1918 and 6.3 million in 1919. There was a sharp drop in 1920 and 1921, with a sudden rise to the peak of 6.7 million acres in 1922. From this point the acreage has declined and in 1927, in spite of a small increase over 1926, was only 3.7 million acres. The yield per acre was not maintained during the war and has since declined progressively, the reported yields for 1925 and 1926 being the lowest reported since 1890, though a high yield was obtained in 1927. Thus since 1909–14 production rose from around 35 million bushels to the peak of 1922, 103 million bushels, since when the reported crop rapidly declined to some 41 million bushels in 1926.[1] A large part of the increase in acreage occurred in the two Dakotas and was due quite as much to discouragement over the wheat crop as to the attraction of war prices for rye.

The principal rye-producing states, those that usually have over 100,000 acres in rye, are Pennsylvania, Indiana, Michigan, Illinois, Wisconsin, Minnesota, North Dakota, South Dakota, Nebraska, and Montana, with Colorado and North Carolina approaching this acreage. These states have over 80 per cent of the rye acreage of the country, and one state, North Dakota, has about a third of the rye acreage. The reasons for cultivation are not the same in all regions. In many of the states rye fits into a system of diversified grain culture with oats, barley, and wheat; it is prized for green fodder and used on the poorer soils. In the Dakotas, Montana, and Colorado, however, it is commonly a poor-land alternative for wheat in one-crop farming.

From 1890 to 1912 a downward trend in per capita rye acreage was in evidence. Over this period the harvested acreage was almost constant at around 2.1 million acres. During 1913 and 1914 the acreage rose to over 2.5 million acres. Thereafter the war expansion carried it rapidly upward. This trend can be expressed in units representing one one-hundredth of the acre. In the first five years after 1890, the average per capita rye acreage unit was 3.38, in the next five years it was 2.93; in the next five years 2.60; in the next five years 2.49; and during the three years 1910–12, it was 2.28. Had this trend persisted it is clear that at the present time the per capita rye acreage unit would be below 2, which would make the actual acreage something in the neighborhood of 2 million acres. Adjusted for the loss in the market demand of some 5 million bushels of rye as the result of prohibition, 2 million acres looks generous. The actual acreage is at present around 3.5 million acres. How is the difference to be explained?

Some of it may be regarded as unliquidated acreage of war expansion. Some growers may find the export price of rye relatively remunerative. For the most part, however, a different explanation must be sought. To some extent rye acreage is a choice of evils, oats and barley being the other evils. This might explain the persistence of rye acreage in Illinois, Minnesota, and Indiana. But the difference in rye acreage in the Dakotas is in itself enough to account for the difference between 2 and 3.5 million acres. Practically speaking, if one would subtract from the present rye acreage the increase in rye acreage that has taken place in the Dakotas since 1912, the remainder would about correspond to the pre-war rye acreage. In other words, while there have been increases and decreases in numerous other states, the increase in rye acreage, as compared with 1909–13, has taken place in the two Dakotas. In these two states, rye may have replaced either wheat, oats, or barley; for one reason or another, farmers raising wheat, oats, and barley operate under difficulties. The rye acreage in these two states has varied from 1.3 to 1.6 million acres during recent years; the combined acreage of wheat, oats, and barley has varied from 16 to 19 million acres. A shift of a million acres could readily occur, with small effect on the acreage of wheat, oats, and barley in these two states, but with a large relative effect on the rye acreage of the entire country.

[1] Rye furnished an illustration of war expansion equaled by few commodities. Judged by production, the expansion was nearly threefold. Judged by exports, the expansion was about thirtyfold.

Rye Production in Canada

Before the war rye was an insignificant crop in Canada.[1] A small acreage was planted to rye in the Maritime Provinces, Quebec, and Ontario, to meet the needs of descendants of rye-eating nationalities. Since there was no purpose in raising rye on good wheat land, rye was not planted in the Prairie Provinces except for special reasons.

The war stimulated the planting of rye in Canada as in the United States. The acreage expanded from 116 thousand acres, the five-year pre-war average, to the peak of 2,105 thousand acres in 1922–23. Since 1922 the acreage has been steadily contracting and in 1927 only 743 thousand acres were harvested. The average production for the five years before the war was a little over 2 million bushels. The peak production in 1922–23 was 32.4 million bushels. With contraction of acreage the crop in 1927 fell to some 15 million bushels. Some of the increase in the past two decades may of course be attributed to the general increase in the area of land under cultivation.

The rye crop of Canada resembles that of the United States. The type of rye is much the same, the average yield a little heavier. Rye has not attained in Canada the position it occupies in the United States as a rotation crop. The farmers of Canada are accustomed to feeding small grains to domesticated animals and this might be expected to favor the growing of rye; but with the free availability of oats, barley, wheat screenings, low-grade wheat, and mill-feed, it is doubtful whether rye will receive much attention as a feeding stuff in the near future. So long as Canadian distilleries make whiskey, a certain amount of high-grade rye will be required for that product; but this demand will not support much of a crop. Canada has a very large potential rye acreage, resembling northern Europe in this respect. Winter rye does well over large parts of the Maritime Provinces, Quebec, and Ontario. The poorer lands in the wheat belt of the three Prairie Provinces are adapted to rye, and north of the wheat belt lies a stretch in which rye and oats mature fairly well. There is in British Columbia also considerable land adapted to rye but not to wheat. But the very weight of wheat exports from Canada tends to operate against rye, and under these circumstances, further contraction of rye acreage, rather than expansion, is to be expected in the immediate future. In all likelihood, the war boom of rye in Canada will subside more quickly and more completely than in the United States.

Rye Growing in the Southern Hemisphere

South America, south of the 25th parallel, has large regions naturally adapted to the growing of rye, mostly on the east side of the Andes, but also on the west. In Argentina particularly is a large potential rye acreage. Rye is known to do well everywhere within the "Wheat Crescent" and also outside of it, especially to the west and to the south. Before the war there was no incentive for raising rye in Argentina; there was little domestic demand and no export prospect. The area sown was less than 100 thousand acres, and the total production less than a million bushels.[2] In Argentina as in North America, the war provoked an expansion of rye acreage. Since the war, the rye planting has risen to over half a million acres, with a maximum production approximating 4.7 million bushels. Yield per acre has been lower even than in the United States. Rye does not fit particularly well with established rotations, except where alfalfa does not thrive. The population of Argentina is largely of Latin rather than of Teutonic derivation; therefore there is only a small demand for rye bread in a country where the growing and milling of wheat is a major industry. Argentina has a huge husbandry of cattle and sheep and a small though growing count of swine. But in the face of the large corn crop, favorable conditions for the growing of oats and barley, and a large acreage in alfalfa, the prospect of demand for rye as a feeding stuff seems negligible. The rye of the Plate as it appears in European markets is a high-grade bread rye; it is hard, and of relatively high protein content, used like the best Russian rye to strengthen the softer ryes of

[1] Appendix Table III shows acreage, production, and yield per acre of rye in Canada, 1890–1927.

[2] See Appendix Table IV.

northern Europe. The extent of rye production in Argentina in the near future would seem to be conditioned upon the recovery of Russian export of rye and upon the costs of producing rye in particular regions of Argentina contrasted with that of wheat. Apparently rye has found a small niche in the agriculture of Argentina. There seems little question that, quality considered, rye can be produced in Argentina and delivered in Europe at a price that would not be regarded as remunerative in North America. Whether this is enough to make it worth while in Argentina to plant rye rather than other crops remains for future development to make clear.

In South America, outside of Argentina, insignificant amounts of rye are grown in Chile and other countries. In New Zealand and Australia also a few thousand acres are planted to rye. In South Africa before the war rye had a greater prominence than in Argentina, due in part to the rye-eating habits of the Europeans who had come mostly from lower Rhine stock and to the characteristics of the soil and climate which were not particularly favorable to wheat. But in absolute terms acreage has always been small, less than 150 thousand acres. The entire rye acreage of the Southern Hemisphere does not exceed a million acres, and under these circumstances a minute tabulation may be dispensed with.

Rye Marketing

The marketing of rye in the United States before the war was very simple. There were nine important primary markets—Minneapolis, Duluth, Milwaukee, Chicago, Omaha, Kansas City, Peoria, St. Louis, and Toledo; since the war Indianapolis has been added to the list. Minneapolis, Duluth, Milwaukee, and Chicago outranked all others and handled close to 90 per cent of the merchandised crop. Records exist of receipts to, and shipments from, these primary markets; also of the visible supply of the United States (commercial and unofficial), including all reported markets, but by no means complete.[1]

Since most of the merchandised rye was raised in the northern states, the seasonal course of receipts, shipments, and visible supply was relatively uniform. May–July were ordinarily the low months. With the harvest, transactions would rise to the peak in September–December (in one season earlier, in another season later), gradually declining to the end of the year, with variations from season to season. Usually the peak of the visible supply lagged one, two, or even three months behind the peak of receipts and shipments. The visible supply consisted largely of stocks in the hands of, or awaiting deliveries to, millers and distillers.

For the highest pre-war year (1912–13), the total receipts at the primary markets were 16.4 million bushels, with the highest receipts for any month not as much as 3 million bushels; the total shipments for 1912–13 were 11.4 million bushels, with the highest shipments in any month at 1.8 million bushels. The highest visible supply during any month of the five-year period was 2.3 million bushels. The carryover of rye in terminal markets was insignificant, since in no year did the visible supply of rye on July 1 equal half a million bushels. To what extent mills carried stocks of rye into a new crop year, or stocks of rye flour, was unknown.

Trading in rye futures was an established practice in "the good old days" of the Chicago Board of Trade. It was for the most part of a desultory character, the specialty (or sport) of a few individuals. The smallness of the crop and scantiness of visible supplies, however, occasionally presented opportunity for manipulation, and corners in rye were several times attempted. Terminal grain dealers and some rye millers hedged their transactions, though the volume of speculative trading was often too low to sustain any hedging. Under such circumstances, grain dealers and millers would sometimes hedge their rye transactions either in wheat or in corn. If the price of rye was high relative to that of wheat, spot rye would be hedged in wheat futures; if the prices of coarse grains were high relative to that of rye, cash transactions in rye would be hedged in corn, or occasionally oats, futures. On account of the small volume of desultory speculation, brokers gradually gave up handling rye accounts, and finally the business centralized in the

[1] See Appendix Tables V–VII.

hands of one man, named McDermott, who specialized in the business. For a time, he executed on the Chicago exchange practically all orders for buying and selling futures in rye, i.e., he acted both for sellers and for buyers, and was therefore familiarly known as "the rye pit." About 1912 trading in rye futures died out.

With the greatly increased crops of rye since the war, the marketing of this grain has assumed a much enlarged importance, accentuated by the heavy amount of rye passing to export and by the re-establishment of trading in rye futures.

Trading in rye futures was formally reopened, under modern regulations, in 1918. The active exchanges are in Winnipeg, Minneapolis, Duluth, and Chicago. When the New York Produce Exchange formally opened trading in grain futures with delivery in Buffalo, rye was included, but this has since been suspended. The only active market for trading in rye futures in Europe is in Berlin.

Cash transactions in rye, when hedged, are now usually hedged in rye futures. Sometimes, however, it is better to hedge cash rye in wheat futures or in corn futures; also, a hedge in rye futures may sometimes be advantageously transferred into wheat or corn futures. In view of the much larger crop, the substantial volume of visible supply, and the relatively big volume of trading, with only the same small volume of milling, the weight of rye hedging ought nowadays to be relatively light. The volume of transactions is small compared with wheat, corn, and oats, but nevertheless substantial when compared with the size of the crop.[1] The large millers of rye flour now hedge their rye transactions; speculators buy rye futures "for investment," and sell short when they think the price too high; elevator companies lay in stocks of rye in the fall and hedge them; and spreaders watch the rye quotations on the different exchanges and buy and sell in the different markets — just as with wheat. In short, since the war rye has again become a full-fledged cereal in the market sense.

The largest post-war figure for receipts came in 1922–23, when 73.9 million bushels of rye were received at the ten primary markets, with shipments of 58.7 million bushels. The month of highest receipts for the year 1922–23 was August, with practically 14 million bushels; the highest shipments for this year were during the same month, 12.1 million bushels. This record was surpassed in a year of smaller crop, 1924, with receipts of 17.6 million bushels and shipments of 16.4 million bushels in October. The highest visible reported in any month since the war was 23.5 million bushels on February 1, 1925, but visible supplies have frequently been over 20 million bushels in different months during the past five years. These large accretions in receipts, shipments, and visible supply have been related to exports and not to domestic movements and disposition.

Before the war, the practices in the marketing of rye in Europe were relatively simple and primitive. Although a large part of the wheat imports of Europe represented interstate traffic and another large part came from Russia, the trade was dominated by shipments from overseas. Thus, interstate European wheat trading, and to a considerable extent domestic trade, had the complexion of international world trade. This was accentuated by the preeminence of Liverpool in the wheat trade, and by the fact that international merchants dealt in the export wheats of all countries. In the case of rye, however, there was little more than interstate trade between Germany and her neighbors in northern Europe, border trade between adjoining countries, and Russian exports into northern and western Europe. In fact, German and Russian imports and exports and the imports and re-exports of the lowland countries were the largest elements in European international trade in rye. With the net imports of the continent, ex-Russia, amounting to some 40 million bushels of rye annually, contrasted with over a half a billion bushels of wheat, the differences in merchandising practices become understandable. Though future trading in rye existed at different times in different continental cities, it had little importance. The imports and exports of rye from country to country were practically on a sample or arbitration basis.

Since the war, European practices in the

[1] See Appendix Table VIII.

marketing of rye have tended more to approach those used with wheat. This has resulted from the greater proportion of rye secured from overseas. With the same importers in Europe and the same exporters in overseas countries handling both rye and wheat, the trading practices have naturally become identical. Russian rye has not appeared on the markets of Europe in the same way that overseas rye has appeared. The export of rye is a state monopoly in Russia. The Russian export association, like the Canadian Pool, has desired to deal with millers rather than with traders. Russian rye has been sold to international traders, but the Russians have preferred to sell it to millers in importing countries and the purchases of rye in importing countries have sometimes been associated with agreements for export of manufactured goods. In a sense, Russian rye exports have tended toward barter, while those of other countries have been conducted on the routine basis of bills of exchange.

II. USES OF AND TRADE IN RYE

Utilization of Rye

Before the war rye had three uses in the United States: as foodstuff, as feeding stuff, and as industrial raw material. Little was exported. The least important commercial use was apparently as feeding stuff, owing to the free availability of coarse grains and the general prejudice held by husbandmen against rye. Before the war rye was raised as a cash crop like wheat, since little was fed on the farm. If one applies the available census data on the milling of rye, it follows that about 30–35 per cent of the rye production was milled. Apart from a certain amount of rye flour used in foundries, the principal industrial use of rye was in the manufacture of alcohol and whiskey. By many, rye whiskey was preferred over corn whiskey. Rye was used in the manufacture of commercial yeast, of which the residue was used in the manufacture of gin, so that rye entered into this beverage also. The amount of industrial alcohol manufactured from rye was relatively small, since other forms of starch and sugar were usually cheaper. Before the war, rye had a large demand in distilleries. Between 1901 and 1914, inclusive, the average amount of rye used in distilleries was 5.3 million bushels, compared with 20.6 million bushels of corn, and 32.8 million gallons of molasses. Contrasted with the size of the crop and the amount of rye ground into flour, the rye used in distilleries was therefore a substantial fraction of the commercial demand. Since the war, the picture has been totally changed. Potable spirits are no longer made out of rye, and cheap molasses has replaced rye in the manufacture of industrial alcohol. During the years 1921–27 the average amount of rye used by distilleries was only 69,321 bushels, contrasted with 5.6 million bushels of corn and 171.7 million gallons of molasses. There is no prospect of revival in use of rye by distilleries. Existing stocks of potable alcohol suffice to cover medicinal use of whiskey for some time, and when new manufacture is begun the amount required will be trivial in terms of rye. So long as cheap molasses is available, largely duty-free from Cuba, rye remains too expensive to be used in the manufacture of industrial alcohol.

The present situation in the United States is quite different. Export has become a major disposition; the use of rye as foodstuff stands almost unchanged; the use as a feeding stuff is increasing; but the industrial use is insignificant.

In Europe, on the other hand, the use of rye as a feeding stuff has always stood next to the use of rye as a foodstuff, above the use of rye as industrial raw material. There has always been some manufacture of rye whiskey in Europe, especially in Great Britain. The Latin countries preferred brandies; the northern countries had cheaper whiskies than rye. Industrial alcohol was rarely made from rye, unless unfit for use by animals, because potato, beet sugar residue, brewery residue, and corn were considerably cheaper. Since rye fitted in with European agriculture so admirably, husbandmen learned early to fit rye into effective feeding practices. Feed rye was almost a distinct trade variety from bread rye; it meant merely the softer grain, low in protein and high in moisture, grown on poor soils in a moist climate. Rye was often

grown on soils that would produce a good feeding rye but that would not produce a passable bread rye. To some extent, the European countries imported feed rye from Russia and occasionally from overseas; but the best policy was to raise feed rye and import bread rye. A relatively large fraction of the millable rye crop was always fed to animals in Europe; for example, in the Eltzbacher report on the German food supply before the war, 25 per cent of the rye crop (outside of seed) was assigned to animals and industry, while only 10 per cent of the wheat crop found corresponding disposition. Everywhere in Europe tail wheat and tail rye have gone largely to animals, but the definition of tail rye was everywhere less strict than the definition of tail wheat.

With prosperity, and with comparable crops of wheat, rye, and potatoes, more rye and potatoes will be fed to animals and less wheat; with a short rye crop, little rye will be fed to animals (unless unmillable) if potatoes and coarse grains are available. Just as adaptations between wheat, rye, and potatoes occur for the food supply, so the peasants make similar adaptations in respect of feeding wheat, rye, and potatoes to domesticated animals.

Characteristics of Rye as Foodstuff and Feeding Stuff

The value of rye in a diversified human diet and in a mixed feeding ration, contrasted with the other cereal gains, may be fairly adjudged according to calories. The nutritional values of the celluloses, starches, and sugars, and of fats in the several cereal grains, are qualitatively practically identical. There are differences in the mineral content and in the fiber, of which the importance is not clear. Apparently the coat of rye is somewhat less digestible than the coat of wheat. Of rye and wheat flours of the same percentage extractions, rye is less digestible and leaves a larger unresorbed residue. But when rye and wheat flours are compared on the basis of identical proportions of bran and germ in the flours, this difference apparently disappears and rye flour is as digestible and well utilized as wheat flour.[1] Apparently, therefore, so far as protein, carbohydrates, and fat are concerned, rye flour is as digestible as wheat flour; the difference lies in the coat. Since the coat of rye is less digestible than the coat of wheat, it follows that whole rye flour is less digestible than whole wheat flour. This may be the expression solely of the difference in quantity of bran, though possibly the bran of rye itself is less digestible than that of wheat.

The protein of rye in a mixed diet is comparable with that of wheat. The plant proteins are judged by their content of, and balance in, amino acids. Of the proteins of the several grains, that of corn is the least well balanced and competent—a point of no importance in a diversified diet containing the customary intake of milk and meat. It becomes important in the diet of the vegetarian and is therefore important in

[1] Considerable discussion has been held over the relative digestibility of wheat and rye. There is no advantage in entering here into a minute analysis; but for the purpose of clarification, some statement seems necessary. The following is presented as reasonable intepretation of the probable truth contained in the conflicting data.

The common experience has been that rye bread is less digestible than wheat bread. Is this due to the flour, to the characteristics of the loaf, or to the type of fermentation? The protein, starch, fat, and cellulose of wheat and rye are apparently of equal digestibility. Short extraction flours (representative of the endosperm and containing neither coating nor germ) seem alike in digestibility. Possibly rye bran may be even less digestible than wheat bran. Widespread confusion has arisen from the fact that wheat and rye breads have been compared without the flours having been themselves initially comparable. One cannot compare a rye flour of 70 per cent extraction with a wheat flour of 70 per cent extraction, because the former contains far more fiber and is less digestible in consequence. One must compare wheat and rye flours of equal fiber content. A straight wheat flour of 74 per cent extraction is from this point of view comparable with a straight rye flour of 66 per cent extraction. Such flours are found to be equally digestible and resorbable. Certainly a white patent rye flour is as digestible and resorbable, or more so, than straight and first clear wheat flour with which it is commonly blended.

But the digestibility of bread may be influenced by other factors than the digestibility of flour. A heavy and soggy bread is not penetrated with the digestive juices as readily as a light and fluffy bread; this would favor the digestibility of wheat bread. Finally, the acids and the other products of the prolonged fermentation used in making rye bread might tend to reduce digestibility. Whether commercial rye breads purchased at random on the market are as digestible and resorbable as commercial wheat breads similarly purchased, is one question; whether rye bread needs to be less digestible than wheat bread is another and different question. It is probably fair to say that commercial rye breads are as a rule less digestible and resorbable than commercial wheat breads; but it is equally true to hold that a rye flour is as digestible and resorbable as a comparable wheat flour.

the feeding of domesticated animals. To the extent that bread occurs in the diet of Americans, it is quite immaterial from what grain it is made so far as the protein is concerned. In the American diet bread is practically a carrier of calories, a fuel.

Rye as a feeding stuff is regarded as somewhat inferior to wheat and slightly inferior to barley and oats, but better than corn. The superiority of rye over corn lies in the protein. Animals fed heavily on corn require supplemental protein to an extent that does not hold for wheat, rye, barley, and oats. Some disadvantage attends the use of any grain fed as an exclusive ration, and this holds for rye just as it holds for wheat and the other grains. Fed in the natural state, the use of rye as a feeding stuff is attended with disadvantages. The gliadin gums in the mouth when masticated; the uncrushed grain escapes digestion. The taste of straight rye is not relished by animals. Rye should be fed ground and preferably mixed with other grains. Thus used, rye is comparable with the other grains in terms of calories, as has been conclusively demonstrated abroad. Rye is commonly used as horse feed in Europe, especially in mixed grain rations. Rye may be hogged down, as corn is, but the practice is wasteful of grain and it is probably better practice, whenever harvesting is not found desirable, to cut for hay or for ensilage. The use of rye has sensible disadvantages with dairy cattle; green rye gives a poor flavor to milk and rye grain makes a butter harder than desired. In the case of bacon hogs, on the contrary, the hardness of the fat is an advantage. In short, the value of rye as a feeding stuff is largely a question of management. When it is advantageous to raise rye, advantageous ways of feeding rye can be worked out. Whenever feed concentrates are purchased on the basis of protein content, rye bran must sell below wheat bran since it is poorer in protein.

Rye is more scientifically used as a feeding stuff in northwestern Europe than in the United States. The feeding yards are more carefully controlled by experimentation and the margin on operations is closer. Bacon pigs, dairy cows, and baby beef steers are fed on rations whose contents in protein and carbohydrate are adjusted closely to the prices of the several feeding stuffs, on the basis of the qualities of products desired. The principal concentrates are skim milk and buttermilk; wheat tailings, screenings, and bran; rye, rye screenings, and bran; feed barley, screenings of malt barley, and malt products; corn; potatoes; expressed meal or oil seeds (cottonseed, linseed, rapeseed, sunflower seed, peanut seed, coconut); tankage and fish meal. These are adaptable within a range of prices; they are substitutive within a range determined by yield and quality of product. The animals are given almost individual attention; the standards of farm management are high; the concentrates are carefully prepared to secure the best digestability, with avoidance of untoward behavior; the prices of concentrates are adjusted from day to day on the basis of protein content; and the animal products are scored and marketed under a system of high official standards. In such a system neither prejudice nor predilection find much place. Under these circumstances, rye finds its proper position as a feeding stuff; it is fed, on the price basis, in such a way as to secure the best return from it. Such an advanced system of animal husbandry is the result of collective action and this is lacking in this country. The majority of American husbandmen are individualists; and since the above system lies outside of the capacity of the single farm, the lessons of European husbandry and the preachments of experts in American agricultural colleges in favor of rye, barley, and oats have had little result.

The Milling of Rye

The milling of rye in the United States and Canada follows current practice in the milling of wheat, though with less refinement. In the older sections of the country some rye is still milled with primitive equipment such as has passed out of use in the milling of wheat except in customs mills. In the large milling centers rye is ground like wheat, but is more simply treated. Rye is usually scoured and brushed, but not tempered, since added moisture is apt to make the kernels tougher. The flour tends to adhere to the bran more tenaciously than in the case of wheat, and a clean separation is more difficult. Rye is

usually crushed on what are known as scratch rolls; smooth rolls do not give satisfactory results. The flour is separated from the bran by plain bolting, the separation depending on the fineness of the mesh, without making use of an air current in the sieve purifier or of aspirators as is done with wheat. The result is an imperfect removal of the bran, even in short patent rye flour. The extractions vary widely from mill to mill and from season to season, as is to be inferred from the census reports on the milling of rye. The mills naturally select the ryes with the largest yield of flour and the lightest color. Recently introduced varieties, such as Rosen and Abruzzi, seem distinctly superior to the older domestic ryes in flour yield.

The principal rye-milling states are Minnesota, Wisconsin, Illinois, Michigan, New York, and Pennsylvania. These six states mill over 80 per cent of the rye ground in the country. The principal quotation points for rye flour are Minneapolis, Chicago, Buffalo, Boston, Philadelphia, and Baltimore. Most of the rye is apparently milled during the autumn and winter. The rye offal finds its way into the feed market with the offal of wheat, the relative prices varying slightly from season to season. Since rye offal is lower than wheat offal in protein and fat, it is less highly prized, and this finds reflection in the price.

Our information on the milling of rye is scanty, fragmentary, and unsatisfactory. The Bureau of the Census does not include rye in its monthly and annual reports on flour milling. The milling journals pay little attention to rye, either currently or annually, as may be noted by reference to reports on rye in the *Millers' Almanac.* For information we are therefore restricted to trade reports and to the reports in the decennial censuses and in the biennial censuses of manufactures.

The scanty information we possess on the production of rye flour is in the censuses of 1899, 1904, 1909, 1914, 1919, 1921, 1923, and 1925.[1] The rye milled and output of rye flour are reported for merchant mills above a capacity that was not identical from census to census. Customs mills were included in some years and excluded in others. Rye flour was sometimes reported in a mixed group with other grains. The data are unquestionably less accurate than the data on wheat. Commercial reporting of flour production, such as has long been practiced for wheat flour, does not exist for rye flour. The data are given in Table 2.

[1] It is worthy of remark that our information on the milling of corn is equally scanty.

TABLE 2.—RYE GROUND AND OUTPUT OF RYE FLOUR IN MERCHANT MILLS OF THE UNITED STATES, CENSUS YEARS 1899–1925*

Census years	Rye milled *(thousand bushels)*	Output of rye flour *(thousand barrels)*
1899	10,088	1,443
1904	11,480	1,503
1909	11,504	1,532
1914	12,814	1,937
1919	15,952	2,528
1921	7,708	1,335
1923	9,246	1,635
1925	8,126	1,561

* Compiled from reports of the U.S. Census. These figures imply what seem to be impossible inferences. In 1899, 7 bushels of rye were required to secure one barrel of flour, in 1914, 6.6 bushels were required. But in 1923, only 5.7 bushels of rye were required to secure one barrel of flour, and in 1925 only 5.2 bushels were required. In other words, rye flour was whiter and shorter patent twenty-five years ago than is the case today. This is so improbable, so opposed to observation, as to be unbelievable.

The amount of rye ground increased gradually from 10.1 million bushels in 1899 to 12.8 million bushels in 1914. Since export of rye flour was negligible, it is apparant that the milling of rye expanded no more than the population increased. The sharp increase to 15.95 million bushels in 1919 may be regarded as a part of post-war European relief. The sharp decline reported in the census of 1921 may be regarded as the result of the return to patent flour wheat bread, both corn bread and rye bread retreating per capita. The grindings reported for 1923 and 1925 were somewhat larger but were still below the level of the years just preceding the war. The reported rye flour outputs tell the same story, though the extractions vary somewhat from year to year.

Minnesota, Wisconsin, New York, Michigan, and Pennsylvania were the prominent rye-milling states at the beginning of the century. In 1914 Minnesota led, followed by Wisconsin, Pennsylvania, New York, and Illinois, which had superseded Michigan.

In 1921 Wisconsin and Minnesota stood in a class by themselves, producing nearly 70 per cent of the rye flour of the country. In the report of the last census of manufactures, for 1925, these two states were credited with approximately 73 per cent of the total outturn of the country. This distribution of rye milling corresponds both with the distribution of rye acreage and of the population of north European extraction.

In many countries of Europe, particularly in eastern Europe, is still to be found considerable milling of rye by primitive methods. The uncleaned and also untempered rye is ground between stone plates driven by water-wheel or windmill and yielding a coarse rye meal. A partial advance on these primitive methods, to be found in central and eastern Europe and in Russia, consists in what is known as plain grinding of rye. This is carried out on corrugated rolls and stone plates. In some instances the rye is ground to flour, bran and all; about 5 per cent of the bran is separated in the cleaning, and the remaining flour is called a scoured flour. In other instances the rye is passed over several breaks, and the bran is sifted away to give a flour of some 85 per cent extraction. This is known as break flour and is not only whiter, but the particles are finer. Most modern mills operate with corrugated rolls, the products being separated into several graded fractions that are known as dressed, sifted, and bolted rye flours. The dressed rye flour is about a 74 per cent extraction; the sifted flour is still finer; the bolted flour corresponds to a patent, and may be as low as, or below, 60 per cent extraction.

The best rye flours, known in Germany and Scandinavia as white ryes, are produced on rolls quite after the current practice in the milling of wheat. These mills produce several grades, corresponding to a series of patent and straight flours, of which the finest is usually less than a 50 per cent extraction. Thus, in the European milling of rye we find flours corresponding to short patent, standard patent, long patent, bakers' patent, straight, clear, and whole rye flour, ground in ancient and modern mills.

The finest rye flours are made in western Europe, the coarsest in eastern Europe; the largest proportion of whole rye flour is made in Russia. The finest rye flour, the shortest extraction, goes mostly to the cities; the coarsest rye flour, the longest extraction, is most used in the country. To this general statement, however, important exceptions exist. For example, the industrial workers in the Rhineland cities are heavy users of coarse and whole rye flour.

Per Capita Consumption of Rye

Consumption of a cereal has either a broad or a narrow meaning. The broad meaning of consumption corresponds to disappearance; it means crop, minus net exports, adjusted for differences between carryover in and carryover out. The narrow meaning of consumption corresponds to ingestion, plus domestic waste. The per capita consumption of rye in the United States can be estimated only in rough figures. Estimates of rye acreage have not received the attention accorded to wheat and are less trustworthy. There is no reliable estimate of carryover. Since the food use of rye is practically confined to rye flour, consumption in the narrow sense is to be arrived at by adjusting flour production of the year for carryovers and net exports.

To estimate gross consumption, or disappearance, the best we can do is to add the figure for visible supply on July 1 to the crop of that year;[1] and from this figure to subtract the visible supply on the first of July following, also the net exports during the year, also seed at the rate of six pecks per acre, without further adjustment for stocks in any position, either in the form of grain or flour. The remainder, including all the plus and minus errors, corresponds to disappearance in all ways, in country and city.

Table 3 contains the figures for the five years before the war and the past six years. During the five years before the war, the highest per capita disappearance was 20.2 pounds, the lowest was 17.5 pounds, and the average was 18.8 pounds. To what extent the concordance was fictitious cannot be guessed.

[1] The visible supply of course does not comprise the total carryover; but other data are not available. There is reason to believe that the rye visible constitutes a larger fraction of the total rye carryover than is the case with wheat.

Since human use of rye in the form of flour was about 6 pounds per person per annum (see below), it follows that two-thirds of the disappearance of rye must have been accounted for by industrial use, animal feed, and seed for planting rye used as pasturage, ensilage, and hay.

Since the war the variations in disappearance of rye have been more pronounced, but the figures have been lower. The highest figure for per capita disappearance was 17.4 pounds, the lowest 8.7, the average 12.6 pounds. The absence of use of rye in distillation accounts for part of the reduction. Beyond that, the figures suggest that less rye has been fed directly, and less rye sown for pasture, ensilage, and hay, or both.

The consumption of rye in the narrow sense, ingestion plus domestic waste of rye flour, is to be measured directly from the milling figures. Pearl[1] included in his estimation of the food supply for the years before the war a computation for rye that was as good as the data permitted. Recomputing his figures for the years 1911–16 into a composite, and using the population of the middle of the period, we find that the consumption of rye flour was a shade under 4 pounds per person per year. This would correspond to something like 6 pounds of rye, as against a disappearance of something approaching 19 pounds, during the same period.

For the post-war period we have three reports of rye flour milling in the biennial censuses of 1921, 1923, and 1925. These are of course incomplete, since the reports exclude merchant mills below a certain outturn and also customs' mills. Let us make an arbitrary guess that the volume of rye flour thus excluded has been 5 per cent and raise the reported totals of rye flour by that amount. Taking the estimated population of the same years, we secure figures for the per capita consumption of rye and rye flour in pounds as follows:

	Rye	Rye flour
1921	4.18	2.54
1923	4.88	3.02
1925	4.15	2.79
Average	4.40	2.78

The figures in the second decimal places have of course no meaning; indeed, the first decimal place is doubtful. Contrasting these figures with those computed from Pearl, one arrives at the inference that the per capita consumption of rye flour since

TABLE 3.—PER CAPITA DISAPPEARANCE OF RYE IN THE UNITED STATES, PRE-WAR AND POST-WAR*

July-June	Crop (thousand bushels)	Visible July 1 (thousand bushels)	Seed (thousand bushels)	Net exports of rye and rye flour (thousand bushels)	Net supply (thousand bushels)	Population[a] (thousands)	Per capita disappearance (bushels)	Per capita disappearance (pounds)
1909-10	35,406	157	3,277	212	31,696	91,530	.346	19.4
1910-11	34,897	378	3,191	(188)[b]	32,257	93,165	.346	19.4
1911-12	33,119	15	3,175	(103)[b]	29,635	94,458	.314	17.6
1912-13	35,664	427	3,835	1,853	29,954	96,144	.312	17.5
1913-14	41,381	449[c]	3,811	2,234	35,416	98,213	.361	20.2
Average	36,093	285	3,458	802	31,792	94,702	.336	18.8
1921-22	61,675	587	10,008	29,934	20,685	109,135	.190	10.6
1922-23	103,362	1,635	7,756	51,654	30,486	110,688	.275	15.4
1923-24	63,077	15,101	6,225	19,816	34,903	112,684	.310	17.4
1924-25	65,466	17,229	5,961	50,229	17,799	114,311	.156	8.7
1925-26	46,456	8,706	5,367	12,641	26,343	115,940	.227	12.7
1926-27	40,795	10,811[c]	5,505	21,694	23,152	117,600	.197	11.0
Average	63,472	9,012	6,804	30,995	25,562	113,393	.226	12.6

* Data from *Agriculture Yearbook, 1926; Wheat and Rye Statistics* (U.S. Department of Agriculture Statistical Bulletin 12), January 1926; and *Monthly Summary of Foreign Commerce.*

[a] Figures for January 1, as estimated by National Bureau of Economic Research.

[b] Net import.

[c] The visible supply on July 1, 1915, was 369 thousand bushels; and 1,255 thousand on July 1, 1928.

[1] *The Nation's Food,* pp. 252–58.

1921 has been somewhat lower than before the war, 4 pounds per capita before the war, 3 pounds per capita since.

These figures illustrate how insignificant is the American consumption of rye. According to Ballod,[1] before the war the ingestion of rye flour per person per year corresponded to 240 pounds in Russia, 133 pounds in Germany, and 94 pounds in Austria-Hungary. According to the report of the Eltzbacher Commission, the German consumption approximated 172 pounds.[2] Post-war data on rye flour consumption are lacking, but incomplete statistical evidence suggests that a decline has occurred in northern Europe. The following data show, for five European countries, the domestic disappearance of rye per capita per year in the pre-war and post-war periods, in pounds:[3]

Country	1909–14	1921–26
Belgium	210	155
Denmark	510	325
Germany	360	245
Netherlands	250	151
Sweden	280	220

Domestic disappearance of course includes seed, feed, and industrial use as well as human consumption. Nevertheless the reductions appear rather large to be attributable to reduced use for these purposes only, or to errors in crop estimates; one may reasonably infer what common observation corroborates—that throughout northern Europe the use of rye flour is declining. These figures compare with an American average domestic disappearance (similarly computed, without allowance for carryovers or seed) per capita in pre-war years of about 22 pounds, in post-war years of about 17 pounds.

International Trade in Rye

Before the war, 95 per cent of the rye of the world was produced and consumed in Europe and Russia; Russia, Germany, and Austria-Hungary produced five-sixths of it. Russia exported rye to Europe and imported from Europe. The United States and Canada had a border trade in rye; the United States shipped a trifling quantity overseas. Argentina also made small shipments overseas. The amount of rye secured by Europe, ex-Russia, from Russia, and overseas sources of supply averaged around 40 million bushels per annum during the five pre-war years. The trade between the several European countries was in larger volume. The imports of the United Kingdom were largely for purposes of distillation, those of the other northern European countries largely for foodstuffs.

In years of normal rye crops, Germany was a net exporter of rye. She exported rye to portions of northern Russia, most of which are now incorporated into Poland, Finland, Esthonia, Latvia, and Lithuania; also, to Scandinavia and to Switzerland. She was at the same time an importer of rye, sometimes of cheap feed rye from Russia, but more often of hard bread rye from Russia and from Argentina. Belgium and Holland were net importers, largely from overseas; Holland was also an active re-exporter of imported rye. The portion of the old Austro-Hungarian Empire that is now Czecho-Slovakia was a net rye importer. The region south of Budapest shipped out varying amounts of rye to the northern countries. The volume of imports of rye depended somewhat upon the proportion of unmillable rye in the domestic crops of the European countries, the tail rye going to animals and being replaced by imported rye. A tabulation of imports and exports among the several states before the war, adjusted to the boundaries of the new states since the war, is impractical for reasons of lack of detailed and trustworthy information.[4]

After 1915, failing to secure grain from Russia, the Allies turned to North America for rye. Before the war, we had exported little rye to Europe, except insignificant parcels for distillation. The rye exports rose promptly to nearly 15 million bushels and remained in that neighborhood during the war. In 1919–20 export rose to 42 million bushels, in 1920–21 to 47 million, from

[1] Karl Ballod, "Die Volksernahrung in Kreig und Frieden," *Schmollers Jahrbuch, 1916,* pp. 77–112.

[2] The striking difference in estimates for Germany was due to differences in production and in rye fed to animals. The true figure lies somewhere between 133 and 172 pounds.

[3] Crops plus net imports or minus net exports, divided by population.

[4] Data on imports and exports of European countries for post-war years, with pre-war averages in part comparable with post-war figures, are given in Appendix Table IX.

which point it has tended to decline to 20 million bushels or less, though exports in 1922–23 and 1924–25 were over 50 million bushels.[1] These exports were provoked by shortage of bread grains in Europe. As was the case during the war, since the war rye has been imported into the countries of the ex-Allies to serve as stretching material for wheat. It has been imported by ex-neutrals and by ex-enemy countries as straight bread flour and as stretching material for wheat flour. Apparently, during the war or since, little American rye has been used in Europe as feeding stuff or material for distillation.

European statistics on rye are believed to be less secure than in the case of wheat, on account of lower accuracy in estimation of acreage, larger use on farms and in rural districts, and smaller proportion passing through the channels of trade. In addition, the changes in the western boundary of Russia have brought into Europe (ex-Russia) countries that before the war were in European Russia. These include Finland, Latvia, Esthonia, Lithuania, Congress Poland, Bessarabia, and a few other small parcels of territory. These were rye-producing and rye-consuming areas, with the exception of Bessarabia where the use of corn was more prominent. Consumption, however, exceeded production for these areas as a whole. Europe, ex-Russia, is therefore a heavier rye importer (or wheat importer) at present than was the case before the war.

The important potential rye-exporting countries of Europe are Hungary, Poland, Roumania, Jugo-Slavia, Bulgaria, and of course Russia. The net-importing countries of note are Scandinavia, Finland, the three east Baltic states, France, Italy, Belgium, Holland, Czecho-Slovakia, Austria, and the United Kingdom. The future position of Germany is unclear. Before the war she was a net rye exporter; since the war she has been alternately a net importer and exporter. Some rye is produced in Alsace and Lorraine, still more in Posen that is now a part of Poland. If Germany could secure the Russian rye available before the war, she might again become a small rye exporter; otherwise, Germany would probably do with rye as Spain does with wheat, import or export a small amount, depending on circumstances.

We regard the present Poland as a potential net exporter of rye, but in fact she is not yet in that position. This is due to a number of factors lying outside the grain-raising capacity of the country in relation to population of human beings and animals. Peasants sell rye and feed oats and barley or feed rye and sell oats and barley, according to prices. Rye is exported in the fall and reimported in the spring, usually in larger amount. The government is now building a rye reserve for protection of supply and control of price.

The relations everywhere have been highly irregular since the war, on account of trade barriers and disorganization of currencies, and are just becoming restabilized. It is, however, noteworthy that while the volume of rye imported into the present Europe from Russia and overseas has tended to be larger than the imports of the pre-war Europe from Russia and overseas, the volume of trade between the different states of Europe has been substantially smaller.

Striking has been the increase in the overseas trade, and in some years in the shipments of Russia. Both have been irregular, high in some years, relatively low in others. In 1923–24 Russia exported over 53 million bushels of rye, a figure not equaled in the five years prior to the war; in the following year, the Russian exports sank below 3 million bushels. In 1924–25, the year of lowest Russian exports, the United States exported over 50 million bushels, largely to Europe; in the following year only a fourth as much was exported. The exports of Canada, insignificant before the war, exceeded 6 million bushels in each of the past five years, and reached nearly 10 million in 1922–23. The exports from the Plate, averaging less than 300 thousand bushels in the five years before the war, have risen to ten times that figure. Holland continues to be an importer of rye for purposes of consumption, but is no longer prominent as a re-exporter of imported rye. Scandinavia and the countries east of the Baltic Sea, which used to secure a part of their rye from Germany, now secure it largely from overseas. International trade in rye, both as to routes and quantities, has

[1] See Appendix Table II.

been strikingly changed since the war; but to a large extent it has been an abnormal development.

Russian exports and imports of rye since the war may fairly be termed incidental or accidental episodes, rather than the expression of agricultural potential. The combination of dictatorship of the proletariat, disorganization of currency, breakdown of transport, crop failure and famine, and state control of import and export trade has prevented Russia from contributing to Europe anything like the amounts of wheat and rye that were to have been expected on the basis of pre-war experiences. Russia has lost northwestern provinces that were rye importers; therefore her failure as a rye exporter is all the more notable. Rye is raised more or less all over Russia, but the distribution of the crop was more to the northward, with wheat and maize to the southward. Rye is the staple cereal of Russia and is raised as food for peasants even in the areas of the Volga and in the Ukraine. Under pre-war Russian landlordism, rye was raised for domestic foodstuff and wheat was raised for export. With parcellation of the land this has ceased to be true; the peasants consume more wheat and less rye relatively, but absolutely more of both combined. It seems likely that the same effect is everywhere to be expected in Central Europe—parcellation of the land is followed by improvement in the country standard of living, favoring wheat as against rye.

The question of prospective Russian exports is as important for rye as for wheat. Before the war average Russian net exports of rye were around 27 million bushels and of wheat around 165 million bushels.[1] Is there a prospect (and if so at how early a date) that European Russia of the present boundaries will again export as much rye and wheat as was exported before the war from the same area? Or have the changes in Russian agriculture since the war conduced to a changed level of exports?

The exports of wheat and rye from Russia before the war were mostly the expression of the outturn of large estates and to a substantial extent represented exploitation of tenants, land workers, and small peasants. Today, title to the land rests, in theory, in the state; but occupancy, use, and tenure rest in the peasant. Occupancy includes control over farming, and tenure may be transmitted to the next generation. Russian peasants apparently regard the status as equivalent to possession. In effect, therefore, parcellation of the land has been accomplished in Russia. This has been accompanied by changes in agriculture, with the trend toward animal husbandry and in the direction of a higher standard of alimentary subsistence.

The Soviet state has every incentive to favor exportation of cereals. Indeed, with each year the purchasing power of exported cereals becomes increasingly more important. Therefore, the "procurement" of exportable surpluses, their expedition from points of collection to dispatching points for export, and their sale in the importing markets of Europe, are a first concern of the Soviet government. They have failed to bring out the available supplies, through inexpert management; but they have not relaxed on the project of exports through lack of incentive.

From the standpoint of the peasants, however, the incentives of cash sale seem not to be maintained. The peasants are building up their animal husbandry; thus more grain is consumed on the farms. Russia has the traditional practice of carrying large stocks. The importance of these stocks is intensified in the peasant mind by the recollection of the famine of 1921; it is accentuated by the increase in the count of domesticated animals. With each year, the peasants seem to find themselves able to get along with fewer of the city-made articles to which they had become accustomed before the war. They are returning to more primitive farm implements. Household industries are being revived; the family of the peasant is becoming more self-sufficing. Perhaps most important of all, the peasants have found during recent years a striking disparity between the amount of grain they sold for export and the amount of goods and implements received in return. In short, the effective incentives of the peasant class for export of wheat and rye are, for the time being, apparently on the decline.

[1] These figures would be different when adjusted to conform to the changed boundaries of Russia on the west.

The export program for the present crop year has fallen down badly; nothing like the amount of wheat and rye that came out of Russia last season will come out of Russia this season. In explanation, in addition to official estimates of a smaller crop of wheat but a larger crop of rye,[1] we are told that the peasant is building up stocks, is disinclined to sell at current prices, and that larger exports are to be expected only in the event that several large crops shall have filled the farm stocks to overflowing. Furthermore, if Soviet authorities are right in adjudging standing estimates of pre-war crops as far too low, Russian domestic consumption may not have recovered as yet to a level permitting considerable exports.

If this statement of the situation in Russia, in itself reasonable and plausible, is correct, then it does not seem likely that an early return of Russian exports of wheat and rye to the pre-war level is to be anticipated. Fear of famine is ingrained in the Russian peasant. A crop failure is expected every so often (rather often) in southern Russia, especially in the region of the Volga. Just as squirrels, according to popular belief, hoard for a hard winter, so Russian peasants hoard for the year of crop failure. It is not unreasonable to infer that the reported building up of stocks, if it is actually taking place, is in part the result of widespread fear that another crop failure is about due.

The expansion in United States export trade in rye since the war has been one of the most striking of the post-war expansions. This is made evident by contrasting the average export of the five years before the war, 800 thousand bushels, with the average export during the years 1921–27, which was around 31 million bushels. Though clearly forecast in post-war conditions in European agriculture, the trade came to the United States almost unheralded, a direct continuation of our expanded war agriculture. Since 1922 the acreage has gradually declined, with little agitation over the rye surplus problem. Our exports of rye to Europe have held on long and heavily, largely because of the delay in Russia's return to the export trade.

We are advised by responsible European importers that the ryes shipped into Europe from the United States since the war have been consistently disappointing in quality, and have often sold for 4–5 cents per bushel below Russian rye. They have been soft, low in protein, and gave a low yield of flour. It is the experience of mills in Scandinavia, Holland, Belgium, and Germany that average No. 2 Western rye has been distinctly inferior to the ryes secured from Poland, the Danubian area, Russia, and the Plate, adapted better for use in distillation and as feeding stuffs than to the manufacture of flour.

At the beginning of the crop year, or as soon thereafter as crop estimates become available, tables of European wheat import "requirements" are prepared in Europe and in the several exporting countries. These tables are revised month after month, as additional information becomes available. Discussions of such tables are frequently to be found in WHEAT STUDIES. The European rye crop is one of the elements in setting up the table for European wheat import requirements. No corresponding tables of European rye import requirements are set up, except in a desultory and fragmentary manner. The variables are numerous, the fluctuations wide. Predicating stated wheat and rye crops in Europe, and stated exportable surpluses of wheat and rye available to Europe, and setting up a figure for gross wheat requirements, one might forecast a probable figure for import of rye. For example, on the basis of the present crop reports, it has been suggested that during the crop year 1927–28 European wheat requirements would be around 640 million bushels and rye requirements 50 million bushels. The forecast for rye would be the more hazardous. If one were to forecast European wheat requirements at 640 million bushels and European rye requirements at 50 million bushels, and the actual outcome were to be 620 million bushels of wheat and 30 million bushels of rye, the miss of 20 million bushels would be a small matter in the case of wheat but a large mistake in the case of rye.[2] It cannot

[1] The wheat crop of 1927 is estimated at 750 million bushels as compared with 810 million in 1926; the rye crop of 1927 at 968 million as against 897 million in 1926.

[2] During the present season, European imports of rye will probably be modified more by European imports of barley than by European imports of wheat.

be assumed that Europe needs a fixed (computable) amount of bread grain, and, if less wheat is secured than planned, the difference will be made up with rye. We have therefore not felt it justifiable or advantageous to attempt to set up in advance a table of importers' requirements and exporters' supplies of rye, corresponding to the tables that play such a prominent rôle in the study of wheat.

III. CHARACTERISTICS AND CONSUMPTION OF RYE FLOUR AND RYE BREAD

Characteristics of Rye Flour

As we have seen, the larger commercial mills in the United States sometimes make as many as four grades of flour called respectively white, pale, dark, and straight rye flour. The extractions vary from season to season, and from region to region. White rye flour is often of a lower extraction than 50 per cent of the grain; a straight rye flour is rarely as much as 70 per cent. The pale and dark gray flours stand between the white and straight flours. Clear flours are usually not separated, but go into millfeed. There is little production of whole rye flour in this country; what passes as such is usually straight flour with bran added. Rye grits and groats[1] are practically unknown in this country. The most common flours are white and (medium) dark, these being most widely quoted. White rye flour is a short patent, dark rye flour practically a (low) straight flour. The standards for color, ash, fiber, acidity, and protein content are not so well developed as for wheat flour; also, they are less important. Rye is usually ground in separate mills; but there are advantages if the rye mill is one of the units in a wheat milling company, since this facilitates the disposition of the offals.[2]

In rye milling there is less blending practiced than with wheat. For the most part, mills grind the rye of the region and do not draw rye from distant sections in order to produce a uniform flour. In other words, quality and uniformity are less important with rye flour than with wheat flour.

Rye flour has a specific odor and taste, and these extend to baked products. The taste and odor are so penetrating as to be obvious in bread made of wheat flour containing only 5 per cent of rye flour. It is therefore possible to make bread with a rye taste out of wheat flour with a relatively

[1] Cracked, crushed grains, sometimes hulled, grits being finer than groats.

[2] It may not be out of place to comment on flour grades. Milling practice and terminology vary from locality to locality, from mill to mill, and from season to season. In effect, though not in direct operation, the mill divides the berry of wheat into two fractions—flour and millfeed. The flour is commonly called straight flour and represents from 70 to 74 per cent of the weight of the cleaned wheat. During the war, for example, the American mills manufactured a uniform straight flour of about 74 per cent extraction. There is considerable marketing of straight flour, but for the most part patent flours are prepared from it. The straight flour is divided into two fractions—patents and clears. The patent flours represent purifications, particularly reduction of color, acidity, ash, and fiber. Patent flours are short or long, depending upon the amount secured from the straight flour. A long patent flour, for example, is one secured with the removal of, say, 5 or 10 per cent of the straight flour. A short patent flour is one secured with the removal of, say, 20 or 30 per cent of the straight flour. The fraction removed from straight flour, when purified in the making of patent flour, is called clear flour. When a short patent flour is manufactured, a fine clear flour is secured. Large mills manufacture several grades of patent flours, representing various degrees of refinement. Correspondingly, they produce two or even three clear flours. Usually the third clear flour, and sometimes the second clear flour, goes with the red dog into feed. The first clear flour goes largely to export, into rye blends, into self-rising and cheaper bread flours, and into industrial use. The finest, shortest patent goes mostly into the family trade. The terms are rather loosely used. Thus, the straight flour of one mill may be practically identical with the long patent flour of another mill.

By extraction is meant the percentage of weight of wheat recovered in a particular flour. A straight flour of 70 per cent represents 70 per cent of the weight of the wheat used in grinding it. A patent flour of 50 per cent extraction represents a short patent in which half the weight of the wheat is recovered.

The practical miller, in defining patent flour, applies the percentage to the straight flour, not to the original wheat. Thus, "90 per cent flour" and "70 per cent flour" represent respectively patent flours containing 90 and 70 per cent of the straight flour, 10 and 30 per cent of clear flour being recovered. If the straight flour were a 70 per cent extraction of the wheat, then a "90 per cent flour" would represent a 63 per cent extraction of the wheat and a "70 per cent flour" would represent a 49 per cent extraction of the wheat.

The same technical and grading expressions are applied to rye flour, but with less precision and refinement. Correspondingly, there is with rye flour less precision and refinement in the determination of color, acidity, ash, and fiber.

small admixture of rye flour. The taste and odor of rye are such as seem to lend themselves naturally to use with meat, cheese, and vegetables, rather than with fruits and sugar. In consequence, rye lends itself poorly to the manufacture of breakfast cereals, cakes, pastries, and confections. This holds true even in the European countries that consume rye extensively; their sweet baked goods are usually made of wheat. Nevertheless, one sees on the American market such combinations as raisin rye bread, orange rye bread, and others. Millers of wheat flour advocate the use of fruit breads in the hope of increasing the consumption of flour; growers of fruits support this in striving to increase the consumption of fruit. Wheat having set the example, rye follows suit. In Europe caraway seed is commonly added to rye bread, a practice also followed in this country; this is done, supposedly, less for the flavor than for the stimulating effect of the essential oil of caraway on fermentation!

The public does not associate whiteness with rye flour as with wheat flour. Also, the conditioning and maturing of rye flour are not so important as with wheat flour; rye flour does not gain as much relatively by being matured as wheat flour does. Rye flour, however, is the more perishable.

In Europe the rye flours vary from country to country. The shortest white ryes may be as low as 50 per cent extraction. Straight rye flour is commonly 68 per cent extraction. Between the short patent and the straight flour appear several grades of gray flours. Clear rye flour also is common in Europe. Since the war there is considerable milling of whole rye flour in different European countries; straight rye flour mixed with bran is also manufactured. Before the war, the manufacture of rye grits and groats was widespread. Since the war this is on the decline, apparently in favor of whole rye flour. What is called whole rye flour is rarely over a 94 per cent extraction, since about 6 per cent of the weight of the kernel is removed in the act of cleaning.[1] With the decline of manufacture of grits and groats and increase in the milling of whole rye flour, bakers of whole rye bread in Europe have learned that to meet public taste whole rye flour must be ground fine. Finding it difficult to make an acceptable rye flour of over 84 per cent extraction, unless the endosperm is milled fine, the European mills now incline to the practice of preparing their so-called "graham-rye" flour by sifting rye bran back into a finely ground straight flour.

Before the war the most popular single rye flour in northern Europe was a finely ground flour of about 82 per cent extraction. Since a straight rye flour in Europe—using the term as comparable with their straight wheat flour—was around 68 per cent extraction, the popular flour of 82 per cent extraction represented a half-way product between straight and whole rye flour. A somewhat lighter flour remains the favorite post-war rye flour in Europe. As a rule, darker flours are preferred in country districts and lighter flours in the city. The proportions of these several flours vary from country to country and from season to season. They also vary with the size of the domestic crop, the price level of bread grains, and the prosperity of the country.

The European mills try to turn out uniform rye flours and, in order to do this, import ryes to blend with domestic ryes. In this sense, the manufacture of rye flour in Europe compares with the manufacture of wheat flour in the United States. Buffalo mills sometimes import hard Canadian wheat to blend with domestic wheats, and Pacific Coast mills import hard wheat from Montana and Kansas to blend with local wheats; just so the large mills in northern European cities import ryes from neighboring countries, from Russia, from North America, or from Argentina. They endeavor to secure hard rye rather than soft rye. From Russia and the Plate hard ryes are to be secured; from North America come ryes rarely better and often not so good as the usual ryes of northern Europe. The harder type of rye is generally used in making flour for consumption in cities; soft rye suffices for the making of country flour. The criteria of and public taste for rye flours are better established in Europe than in the United States.

The protein content of rye flour is substantially lower than that of wheat. In this

[1] Rye is scoured and brushed in machines of varying construction (in Europe, the cleaning is often done between stones), whereby the outside of the husk is removed, 5 or 6 per cent of the weight being lost.

country, rye flour is often stated to have only half the protein content of wheat flour. Such a wide difference is not to be found in European analyses. Corresponding European analyses give a much higher protein content for rye flour and a somewhat higher protein content for wheat flour, the difference between the two, therefore, being less than in the American analyses. This is partly due to difference in extraction, in part however to the fact that American ryes are not so good as European ryes. For both wheat and rye flours, American chemists use a lower factor for conversion of nitrogen into protein, so that all American analyses give lower results for protein than European analyses. It is safe to state for comparable flours that the protein content is always higher for wheat than for rye; it may be a fourth higher, a half higher, or twice as high, depending on circumstances in milling and on the grains from which the flours have been derived.

When wheat flour is moistened, worked into a gummy mass, and washed with water, a crude protein is isolated that has long been called gluten. When rye flour is manipulated in the same manner, no corresponding recovery of gluten occurs. But since the dough of rye flour behaves under fermentation like the dough of wheat flour, it must contain a gluten-like material. When, in isolating gluten from wheat flour, rye flour is added, the yield of gluten is reduced; something in the rye operates against the isolation of wheat gluten. When, however, the isolated gliadin (see below, p. 204) of rye flour is added to wheat flour, this does not operate against the isolation of the gluten, but increases it proportionately, just as if one added gliadin isolated from wheat flour. Therefore, the inhibitory factor in rye flour lies outside of the gliadin. Not only does rye flour behave like wheat flour in dough under fermentation; but when the proteins are isolated from the two flours, it is found that the principal protein of rye is very similar to one of the two principal proteins of wheat. It is therefore natural to speak of rye containing gluten, even though it cannot be isolated by washing; and since it is advantageous to use the term gluten in this general sense, we invoke the indulgence of the cereal chemists for so doing.

The bread grains, wheat and rye, are thus characterized by the presence of gluten. Maize, barley, oats, rice, and the sorghum grains contain no gluten or gluten-like proteins. Suspended in water, gluten forms a gum-like mass, tough, elastic, and distensible. Inflated with gas, glutens form sponge-like masses, the volume of which is enormously larger than that of the original material. Under distension, gluten will expand to twenty times the original volume. The gluten of wheat contains two proteins, glutenin and gliadin. Glutenin and gliadin are difficult of quantitative determination, but enough is known to indicate that they make up the largest part of the protein of wheat flour, being present in approximately equal amounts. Rye contains gliadin. The gliadin of rye is not identical with the gliadin of wheat, though very similar. In quantity, gliadin is present in rye flour to much less extent than gliadin and glutenin in wheat flour. Also, qualitative differences in the glutens of the two flours exist, with superiority on the side of wheat.[1]

[1] In order that the efforts made above to present the subject untechnically may not lead to misinterpretation, certain amplifications and qualifications seem desirable. Gluten is the name applied to the elastic protein that may be obtained from wheat flour through the action of water. One cannot isolate gluten from rye flour by washing. But on the basis of behavior in dough, rye flour contains a colloid that has the right to be called a gluten even if it cannot be isolated by washing, and we shall use the term here. Like all proteins, gluten is a colloid—an emulsion colloid with special characteristics. Crude gluten may be purified by appropriate methods. As components of gluten, two proteins may be identified called glutenin and gliadin. Glutenin is now classified as a glutelin, while gliadin is regarded as a prolamin. Wheat flour contains both glutenin and gliadin in variable but usually about equal proportions; rye flour contains also a glutelin, but not identical with the glutelin of wheat and not present except in traces. The gliadins of wheat and rye are apparently not identical chemical individuals.

The qualities of glutenin and gliadin are modified by their behaviors when suspended in water, depending on the presence, and concentration, of acids, alkalis, and salts. All colloids when mixed with water form phases that are modified (*a*) by acidity or alkalinity, (*b*) by the degree of acidity or alkalinity (concentration or hydrogen potential), (*c*) by the presence of electrolytes, regarded merely as carriers of electrical charges, and (*d*) by the presence of electrolytes whose cations or anions exert specific influences as elements aside from their electrical charges. All phase reactions take time for development: within limits, increase in temperature hastens developments. Also, the velocities of phase reactions are modified (temperature constant) by changes in the media related to acids, alkalis, and salts. These time relations possibly correspond to the so-called "development" of the dough. These several relations are only partly ex-

Rye dough expands less than wheat dough; other things being equal, wheat bread is always lighter than rye bread.

When wheat or rye flour is mixed into a dough, following the addition of yeast we have the familiar rising of the loaf consequent on the evolution of gases of fermentation. The individual air-cells of the sponge-like mass do not as a whole communicate, and the loaf is thus distended. Breads made from the other grains cannot be raised with yeast in the same way, because they do not contain the elastic glutens. Breads made with baking powders are sometimes called quick breads, as distinguished from yeast-risen breads. Quick breads can be made with the flours of maize, rice, oats, barley, and millet, but not yeast-risen dough breads. Both yeast-risen and quick breads may be made from wheat and rye flours. Nowadays most quick breads are made with the addition of enough wheaten flour to make the use of baking powders practicable; but in earlier times corn pone, rice cakes, and oaten scones were made straight. Commercial bread-making rests upon the adsorption of water by gluten and distension of the loaf in the fermentation of the dough.

Both wheat and rye are poor in fat, but rye flour is the poorer. Rye flour is slightly more starchy than wheat flour. So far as heat values are concerned, the larger content of starch practically balances the smaller content of protein and fat; therefore, comparable wheat and rye flours differ but slightly when rated by calories. Wheat flours run from 1,620 to 1,700 calories per pound, with rye flours 20 to 50 calories poorer (with standard moisture).

plored for the best-known colloids, and are less well known for gluten than for some other colloids. Not only does a particular colloid exhibit strikingly varying behavior under different concentrations of acids and electrolytes in the system, but two colloids may behave in a manner different from that which either would exhibit alone, other things being equal. This point is of particular importance in relation to the bread grains, since it is not unreasonable to expect that gliadin alone would behave differently than when mixed with glutenin. To some extent, other things being equal, the different behaviors of wheat and rye flours might be due to the fact that rye contains largely gliadin while wheat contains glutenin and gliadin, thus modifying the phase.

When studied in the isolated state, the gluten of rye behaves like that of wheat, only to lesser extent. The emulsion of rye gluten is less viscous, more soluble in water, takes up less water in the phase reaction and displays less swelling. The sponge structure is less elastic, and has a softer feel, resembling, by way of comparative illustration, a soap suds rather than whipped white of egg. These varying behaviors of the isolated proteins find their counterpart in the behaviors of wheat and rye doughs. While rye gluten is less viscous than wheat gluten, watery suspensions of rye flour are more viscous than those of wheat flour. Because this viscosity of rye flour is little affected by acidity, and for other reasons, it is inferred that it may be due to the influence of components of the carbohydrate fraction of the flour.

At the present time, investigators seem to be divided in their views. According to one view, the qualities of glutenin and gliadin are inherent, predetermined in the seed, and therefore subject to modification by plant breeding. In particular, the bilateral relations of the two colloids to each other in the phase system are regarded as determined largely by the glutenin. The other view finds in the acids and electrolytes in the kernels of wheat and rye the principal causes of the varying behaviors of glutenin and gliadin. Under this view, the colloidal properties of wheat and rye flours might be modifiable in the act of milling and baking. That the addition of electrolytes in certain proportions and of acidity to a certain extent would modify the behavior of the gluten in the dough, fits in with either view. These two views are of course not exclusive; there is probably truth in both. We may expect future investigations gradually to separate those qualities of glutens that are inherent in the chemical constitution of the molecule from those referable to environment in the phase system.

The Characteristics of Rye Bread

The characteristics of a bread are both physical and chemical. They depend upon the grain used, the type of flour employed, the ingredients other than flour, salt and yeast, the type of fermentation, and the method of baking. Once baked, breads become stale or retain their freshness, depending on circumstances. Rye breads are unlike those of wheat as a result of differences on all the points mentioned.

A loaf may have a thick or a thin crust; it may be light or heavy, fluffy or tough; it may be relatively wet or dry. It may have large holes or small holes; it may have a dense or a light texture; it may be crummy or sticky. On all of these points, variations are less important for rye than for wheat bread, both in Europe and in the United States.

To the baker the number of loaves to be secured from the unit of flour is important. On account of the larger content of gluten, and better quality, wheat flour absorbs more water in the dough than does rye flour. At the same time, a rye bread is usually more soggy than a wheat bread, the sogginess being due to the texture rather than to the absolute water content. Cer-

tain rye breads, however, have a high water content, due possibly to the action of lactic acid.

The flavor of a bread is the composite result of many factors. Naturally, the flavor of a plain bread, such as is almost universal in Europe, differs from the flavor of a bread containing milk, shortening, and sugar, such as is becoming universal in the United States. As a witty American baker has put it, it is the difference between plain bread and poor cake. The flavor of a plain bread includes both taste and odor. The flour of each grain has its particular flavor, brought out when the flour is mixed with water and baked. The yeast itself develops a flavor, as may be determined if a cake of yeast is spread thin and baked. The action of yeast on the flour in the act of fermentation produces a flavor, different in wheat and rye. Incidental products of the fermentation, such as lactic acid, contribute a flavor of their own and seem also to develop a flavor in the loaf. Finally, the flavor of bread is influenced by texture, since the taste of bread is brought out by mastication. Naturally, a bread eaten straight tastes different from a bread used as a vehicle for spreading materials.

Breads are of two types—sweet and sour. Sour means acid; sweet means merely lack of acid taste—blandness, not the sweetness of a sugar. Sour wheat breads are liked in some countries, for example in some parts of Scotland and France. Wheat bread does not so readily become sour as rye bread. American bakers try to keep rye bread sweet, or at least only faintly sour. In Europe rye bread is usually sour, except the palest rye-wheat breads; indeed, sourness is sought in certain types of rye bread and sour buttermilk and skim milk are added to accentuate the acidity.

Bread dough may be fermented by the addition of a culture of yeast. Fermentation may also be started by the use of sour dough, usually saved over from the previous batch. (Sour dough is *Vorteig* in German, *levain du chef* in French.) In some countries cheese, buttermilk, and sour milk are used as sources of yeast in the preparation of bread. The use of yeast cakes has almost entirely superseded the use of sour dough in the United States. In Europe, on the contrary, sour dough is widely used in all countries, not merely as continuation of an old custom, but because certain types of bread can apparently be made more cheaply and uniformly with sour dough.

The acids commonly present in bread are lactic, acetic, and occasionally butyric. When one studies the products of fermentation induced with yeast, alcohol and carbon dioxid are seen to be the products of one group of fungi, while lactic acid is the product of another. Thus we speak of alcoholic fermentation and lactic acid fermentation. It is the yeast of alcoholic fermentation that lies at the basis of bread-making. In the fermentation of sugar to alcohol, lactic acid is an intermediary stage; but under normal conditions it remains among the end-products in traces only. In addition, in the fermentation of the loaf fungi are also encountered normally producing acetic acid, probably out of alcohol. Occasionally, fungi which produce butyric acids are also present and active, but this is to be regarded as adventitious and abnormal. Butyric acid is highly undesirable in bread, on account of its disagreeable odor. Bread bakers once obtained their yeast from breweries. Later, the manufacture of bakers' yeast became a specialty, in order to obviate the dark color and taste likely to contaminate brewers' yeast, and to secure high and uniform activity. Bakers' yeast contains organisms producing both alcohol and lactic acid. Indeed, the acid is regarded as a stimulant to the fungus of alcoholic fermentation. A sour dough contains cultures producing alcohol, lactic acid, and acetic acid; also butyric acid, when the sour dough goes bad, as is frequently the case. Even where sour dough is saved out of the last batch and remains uncontaminated, it is likely to lose its strength and every so often a fresh start must be made with the use of commercial yeast. In modern times some bakers prepare sour dough for each batch of rye bread. Fermentation with yeast cakes that have been prepared under carefully controlled conditions of culture yields fewer adventitious products than does sour dough.

The water content of bread depends upon many factors, including ingredients and procedures. The commercial standard of moisture is the maximum amount of water consistent with the customary and desired

characteristics of the loaf. Other things being equal, rye flour absorbs less water than wheat flour and the dough expands less. But rye bread retains moisture longer than wheat bread with the same kind of a crust; and rye flour lends itself to the baking of a crust that will retain moisture in the loaf over a long period.

The digestibility of bread and the absorption of the products depend upon the extraction of the flour, the type of fermentation, and the texture of the loaf. Naturally, digestibility depends in part upon mastication. Some types of bread seem to require more mastication, other types are easily bolted. Bread eaten straight is masticated more than bread eaten with butter or conserves.

The food value of bread, in terms of calories, depends upon the grain from which the flour is obtained, the extraction of the flour, the presence of other nutritive ingredients than flour, and the water content of the loaf. Although the pound of rye flour has slightly less food value than the pound of wheat flour, the pound of average plain rye bread may contain as many calories as the pound of average plain wheat bread, due to difference in water content.

Rye Bread in the United States

Rye consumers in the United States have drifted a long way from, or advanced a long way ahead of, their European forebears. Slavs, Germans, and Scandinavians would regard conventional American rye bread as a nondescript foodstuff, adapted neither to workdays, Sundays, nor feastdays. Our rye breads incline to be imitations of American wheat breads rather than imitations of European rye breads.

The customary rye bread of the United States is not straight rye but mixed rye and wheat. It is made for the most part of so-called "rye blend" flour, containing 25, 33, 40, 50, and rarely over 60 per cent of rye flour. Depending on the bakery, the rye flour used is white, medium gray, or dark. The wheat flour in the blend is usually clear or straight, preferably strong, that is, made from hard wheat. Occasionally bakers' patent flour is used; rarely a short high-grade patent hard flour is blended with a white rye to produce an almost white, light-textured bread with just a faint odor and taste of rye. American bakers try to make the mixed rye breads as bland (not acid) as possible.

Rye flour is marketed just as manufactured, and is also blended with wheat flour. For the household trade there are advantages in merchandising a rye-wheat blend. To what extent rye bread is baked in the home is unknown, but it must be slight. Also unknown is the extent to which home-baked rye bread is made of rye flour alone, of commercial rye-wheat blends, or of a flour mixture prepared in the home. Bakeries naturally prefer to make their own blends, partly because they understand the tastes of their customers, but also because they can thus take advantage of varying prices of the several wheat and rye flours.

Straight rye bread appears on the market to a limited extent in some cities. It is made either of white or gray rye flour. It is heavier and more soggy than rye breads containing wheat flour, and is distinctly more acid. On the basis of flour prices, the ingredient cost may be no less for straight rye bread than for mixed rye bread, since clear wheat flour may cost less than rye flour. Furthermore, the yield in loaves is larger in the case of the mixed bread.

A small amount of rye bread is made of whole rye flour, carrying with doubtful justification the name of pumpernickel. In a few out-of-the-way places, pumpernickel is still made of crushed rye instead of rye flour. Indeed, it is still possible "way down East" to find occasional examples of a coarse rye and corn bread of a type that dates back to pre-Revolutionary times. Modern American pumpernickel is rather a concession to the whole grain cult than a continuation of the German prototype.

Rye bread in the United States is not favored with the additions of shortening and sugar commonly used in the baking of wheat bread. It is usually fermented with yeast, the extent of the fermentation being sometimes controlled with salt; it is a short fermentation process, controlled to avoid acidity. The flavor of rye bread seems to come from the fermentation as well as from the flour. With the same amount of yeast, rye flour tends to ferment more acidly than wheat flour, resembling whole wheat flour rather than patent wheat flour. Since Amer-

ican bakers restrain the fermentation, they thereby reduce the so-called rye flavor of the bread. Most bakers use the sponge method rather than straight dough. Since rye flour contains much poorer gluten than wheat flour, expansion of the dough is only moderate.

Rye bread may be baked either on the hearth of the oven or in tins and is usually baked with steam in the oven. The loaves are usually baked separately in order to have a complete crust. As a rule, bakers endeavor to have a heavier and a darker crust for rye than for wheat bread. The short one-pound loaf is the common loaf, though the two-pound loaf is also baked. Rye breads are usually not wrapped. The more wheat flour in the blend, the quicker the loaf dries out.

Rye bread is not consumed in the United States to any extent as a substitute for wheat bread. Our small consumption of rye rests on taste. Consumption is heaviest in the northern states. Immigrants and first-generation descendants from Slavic, Scandinavian, and Teutonic countries use rye bread from choice. The second generation of immigrants is apt to regard rye bread as carrying a social stigma. Rye bread has acquired since the war a rather widespread use in public eating houses, including the best hotels and clubs. This is the result of the urge for variety. It has become the custom in public eating places and clubs to have several kinds of bread placed before the patron, and rye bread is commonly among them. Before the war, the rye sandwich was associated with beer; since the war it seems to hold its own without beer, as witness the cheese sandwich and the hot corned-beef sandwich. The rye bread used in public eating houses, however, is largely wheat bread with a trace of rye color and flavor, and not much of the rye crop goes into this bread.

Rye Bread in Europe

For a long time home baking of bread has been almost obsolete in most European countries; commercial baking is the rule. Before the war, the bakeries were usually small; large-scale baking, according to American practices, was little seen outside of a few large cities in Great Britain and western European countries. The bakery was essentially a neighborhood shop. Since the war, large-scale baking is on the increase and up-to-date bakeries are being installed. These bakeries, however, work especially with wheat. Rye bread has lagged behind in large-scale manufacture and for the most part is still the product of the small bakery. In short, wheat bread tends to be made with modern methods, while rye bread tends to be made with older methods. This difference continues because wheat and rye breads in Europe are for the most part supplementary rather than competitive; the public has different standards for the wheat loaf ("white bread") and for the rye loaf ("black bread").

Before the war, the bread standards in continental countries, especially in Germany and Austria-Hungary, were greatly influenced by military regulations. What might be called the standard rye bread of the Teutonic countries was made with a flour of an extraction of 82 to 84 per cent. This was the composition of the bread of the military barracks, the *kommiss* bread, and was the customary bread of the working classes. Since able-bodied males served as recruits for several years, and thus became accustomed to the bread of the barracks, this became the controlling taste of the common people. Since the war this is less the case, and the rye bread tends to appear in more diversified forms than before the war.

While rye has for centuries been the common bread of Europe, important shifts and trends have taken place. Rye bread is naturally far more important north of the latitude of the Alps than south. Long ago, barley was widely used in Russia and in Europe in the making of unleavened bread and mixed with wheat and rye. It was replaced by rye and is now rarely used in bread, except as a stretching material. Following the introduction of rice and maize into southern Europe, these replaced rye to a considerable extent; latterly, especially since the war, wheat is replacing them, especially maize. Once common in Great Britain, rye bread is now practically extinct in that country. Rye has always been more the bread of the country than of the city. Everywhere it has been the bread of the working classes rather than of the classes

better situated. Rye was always called the bread of poverty; in the poorest classes wheat bread was known as the bread of the sick-room, of Sunday, and of the feast day. There has long been social difference between the two breads; rye and wheat breads were literally in different castes. Since the war, with replacement of monarchies by democracies, following the decadence of the aristocratic classes and the political supremacy of the working classes, a trend of revulsion against rye is clearly discernible.

This revulsion against rye in favor of wheat is devoid of nutritional basis; under the circumstances it is sociologically foolish and economically unsound. Nevertheless, it exists, and is not to be argued away. The trend against rye and in favor of wheat is intensified by the recollections of war bread. The war breads of Europe were for the most part highly undesirable and unsatisfying. They were also widely regarded as unnecessary. They were loaded with dilutions, stretchings, and sophistications of one kind or another, and these were inflicted on rye bread much more than on wheat bread. These war breads were much more prominent in the countries of the Central Powers, i.e., in rye-eating countries, than in the countries of the Allies.

During the war the Germans maintained an extensive propaganda in favor of rye. The foolish attempt was made to dress up rye as an aristocrat. Assisted by university professors, the food administration of the Empire conducted a widespread and intensive campaign in favor of rye. Rye was pictured as the source of the basal Teutonic virtues, superior to wheat in the building of bone, brawn, and brain. The purpose of this propaganda was to make the German people content with the poor rye bread they were receiving. The effect was negative. Since the war the reaction against war bread has survived, to the injury of rye and to the gain of wheat. Similar reactions against rye are to be observed in Scandinavia, in the low countries, in the succession states of Austria-Hungary, in the Balkans, and in Russia. The European may have always felt that wheat was better than rye; since the war this has become a trend in favor of the higher priced wheat.[1]

The predominating rye bread of Europe is made of straight rye flour without other ingredients than ferment, salt, and water. Mixed rye breads are made in all countries; but straight rye bread is now, and was before the war, the predominating type. The color of rye bread was never dodged in Europe, and all rye breads were commonly known as black breads. There were lighter breads made of flours of shorter extraction, as short as 50 per cent; but when breads were made of short-extraction rye flour, the tendency was to add wheat flour. Rye breads made of whole rye flour were also known in all countries before the war, but the amount was small.

Since the war, the commonest rye bread remains a rye bread from flour of 82–84 per cent extraction, but more and more appears the tendency to use lighter flours and to add wheat flour. Considerable city bread is made of 70 per cent flour. On the other hand, the modern movement for so-called health breads has found expression, more or less all over Europe, in the manufacture of whole rye breads of various types.[2] Some of these are made literally of whole rye, i.e., uncleaned rye; others are made from flours ground from cleaned rye, representing about a 94 per cent extraction. Others are made from finely ground straight flour, or even clear flour, to which bran has been added. Some of these breads are not made from flour at all, but from crushed or cut rye or from grits and groats.

The mixed breads of Europe are important, both nutritionally and economically. Mixed bread has in Europe a totally different meaning than in the United States. Rye may be mixed upward or downward, so to speak. Mixed upward, wheat is used as a strengthener; the product is improved and the price is increased. Mixed downward, barley, oats, corn, and potatoes are used as stretching materials; the product is degraded and the price is lowered. Sometimes bean meal (usually soya) is added to enrich in protein. The mixed rye breads are in the broad sense adaptations between crops on the basis of relative prices.

The mixed wheat-rye breads of Europe are consistently richer in rye than those in the United States. They are made more

[1] This follows from common observation in Europe, but incomplete statistical evidence lends support.

[2] E.g., the "health" rye breads of Steinmetz, Simon, Gelinck, Avedyk, and others.

after the fashion of wheat bread, but they remain rye bread. The hotels serve fairly light rye bread; but for the most part, if a European can afford a better bread than standard rye bread of the region, he is apt to go to wheat bread and not stop off at the half-way station of wheat-rye bread. The motives that induce Americans to affect rye bread, made mostly of wheat, do not exist in Europe. Nevertheless, the use of mixed breads is steadily increasing, and commercial bakers favor mixed breads rather than straight rye bread. One form of mixed bread in Germany is made of left-over wheat bread dough mixed with rye flour.

Notably important are the mixed breads made by degrading rye (sometimes with wheat flour included) with corn, oats, barley, and potatoes. Some of the oldest of these mixed breads are made of grits or groats of rye, oats, and barley combined. Others contain corn. Pumpernickel is the best-known illustration of this type of bread, though in modern times pumpernickel is made out of flours, as well as out of grits and groats. The potato is not usually used in groat bread. Pumpernickel may be either straight rye or a mixed bread, baked or steamed.

Biscuits of rye have long been made in Europe, of straight rye or of mixed flours or groats. The Swedish flatbread is a familiar illustration. These biscuits, properly stored, will keep for months.

Whenever wheat flour is mixed with rye flour to make rye bread, various wheat flours may be used. Whole wheat flour is rarely used except in a few traditional breads. As a rule, clear wheat flour is used in making the cheaper rye bread. Indeed, this is the common method of dumping clear wheat flour, and imported clears are widely used for this purpose. Straight wheat flours are also employed, usually with rye flours of shorter extraction. Some of the lightest rye breads are made of rye and wheat patents.

Usually the flours are blended after being milled, but there is sometimes a sowing of mixed grains, which are then milled together. This, however, is dying out, through the opposition of the mills, since wheat and rye require different tempering and a different arrangement of the breaks in milling. The blending of rye and wheat flours, to make the accustomed loaf at the lowest cost, is a highly developed art in European countries.

Not only is wheat mixed with rye to improve rye bread, and oats, barley, and corn mixed with rye to cheapen rye bread, but potato also is widely used as a stretching material. The use of potato in bread, both rye and wheat, is very old in Europe. It was not originally, and is not necessarily, a stretching material. Potato starch is an excellent pastry material and finds its way into the most delicate confections in European pastry shops. When discreetly used in rye bread, potato improves the quality, particularly if the bread is made with sour dough. The loaf is somewhat lighter, of a finer texture and less soggy, and no flavor is added. Such use of potato ought not to exceed 5, or at most 10 per cent, in terms of dry weight of potato to dry weight of rye flour. Originally the potatoes were cooked and mashed for the occasion, since the use of raw potato pulp proved disadvantageous in several ways. Latterly potato flakes, made from cooked potatoes, have come into general use. Dried raw potato works better than fresh potato pulp, but it is easier to dry cooked flakes than raw potato flakes.

In hard times, or when rye is scarce and potatoes plentiful, larger amounts of potato are used to make mixed potato-rye bread. Under extreme circumstances, the pulp of fodder roots has also been employed. During the war a great deal of rye bread was made in central Europe containing a third and even a half weight of potatoes. Such breads were not good; they were very moist and soggy, highly acid, prone to decompose, and low in protein. War experience with bad potato-rye bread has been followed by revulsion against use of potato in bread. At present, when potatoes have to be used to stretch rye, most Europeans prefer to use them separately and not to mix them into a poor bread.

Rye-wheat breads are usually made with yeast instead of sour dough. It is difficult to make a conventional straight or whole rye bread with yeast. Sour dough seems necessary, but yeast works satisfactorily with mixed flour. With sour dough, long fermentation is the rule. The modern bakeries naturally prefer yeast to sour dough, and this leads them to add enough wheat flour to a rye dough to make the fer-

mentation readily workable with yeast. This procedure of the bakeries, therefore, works in favor of mixed wheat-rye bread, as against straight rye bread. With the use of yeast and mixed flour, a rapid fermentation is sought, but at the expense of acidity and highly developed rye taste. The net result is that in Europe at present city bread tends more and more to contain some wheat and to be fermented with yeast, while country bread tends to remain straight rye and is fermented with sour dough.

Rye bread in Europe is usually made with the straight dough method. The sponge method, however, is coming into favor in large bakeries, especially with mixed breads. Rye loaves are usually baked on stones or on the hearth of the oven, rarely in tins. Baking is usually with dry heat, not with steam in the oven, as is common practice in this country. Most European bakers, especially in the country, try to give their loaves a very hard crust, so that the bread will keep for weeks or even months. The common rye loaf of Europe is the two-kilo or quartern loaf, but one sees loaves up to ten pounds weight.

In judging the rye breads in Europe, Americans must not employ American bread standards. For both wheat and rye, the average bread of the United States is much lighter than in Europe. The common wheat bread of Europe is made of flour of a longer extraction than the average used in the United States, a long fermentation is customarily employed, neither milk, shortening, nor sugar is routinely used, and the bread is heavier. European rye breads are therefore not so far below European wheat breads, so far as the mass of people is concerned, as might be imagined by Americans judging European rye bread by American wheat bread. Breads in Europe, both wheat and rye, are staples in the diet, not vehicles for spreading, as in the United States, and are to be judged accordingly.

IV. PRICE RELATIONSHIPS OF RYE AND WHEAT

The prices of the several cereal grains, relative to each other, are based, on the side of demand, on caloric values and special qualities; and, on the side of supply, on the varying amounts available in the crops. Over short periods, variations in supply are the most influential factors in the determination of relative prices. Over long periods of time, costs of production and consumers' criteria would seem to be the effective factors in modifying relative prices. Demand for cereals for foodstuffs is based more on special characteristics than on energy values, but is influenced by special circumstances on the side of supply or by untoward developments in the channels of trade. Demand for cereals for feeding stuffs ought to be based largely on energy value, modified to some extent by special characteristics. But expert knowledge on feeding values is not the common property of animal husbandmen. Indeed, experience would seem to indicate that farm practice lags behind expert knowledge and may even oppose it.

The several cereal grains are roughly comparable in their uses. As carriers of calories, as sources of energy for human beings and domesticated animals, they are substitutive within a range. They are substitutive in the manufacture of alcohol. Their prices therefore should be relatively comparable, somewhat in the same sense that the prices of different industrial fuels are comparable. The grains are least comparable in their food relations; they are much more comparable in their feed relations. That a relationship tends to exist between the prices of the several grains is axiomatic on the grain exchanges. In street parlance, the grains pull each other up or drag each other down.[1] Fixed differentials between the prices of the different grains might be expected to be more closely approximated in western Europe than in the United States, since foodstuffs and feedstuffs are computed more closely than in this country.

The subject of the price relations of the several grains on the calorie basis contains three separate, though overlapping, questions: the relations of the bread grains to each other, of the coarse grains to each other, and of the bread grains to the coarse grains. Despite the fact that the coarse

[1] No comprehensive study of these price relations, conducted with competent mathematical methods, seems to exist.

grains influence the bread grains, we shall here consider only the relations of the bread grains to each other, since the larger question lies outside the scope of this study.

The price relations of the bread grains in the United States would be one thing if the country were on a strictly domestic basis and something different with the country on the export basis. Before the war we were practically a non-exporter of rye but a heavy exporter of wheat. The foreign influence on domestic prices was therefore large for wheat and insignificant for rye, and of course varied from year to year. Since the war, we have been a heavy exporter of both grains, with corresponding effect upon prices. For rye, particularly, the difference is of importance. Before the war, the rye price was determined largely by domestic influences; since the war, with heavy exports of rye,[1] foreign influences have been of much greater importance.

During the past eighteen years, the price of 60 pounds of No. 2 rye at Chicago has equaled the price of No. 1 Northern Spring wheat at Minneapolis in only one year, 1917–18.[2] The price of 60 pounds of No. 2 rye at Chicago has equaled the price of 60 pounds of No. 2 Hard Winter wheat at Kansas City twice, in 1911–12 and in 1914–15. The price of 60 pounds of No. 2 rye at Chicago has three times equaled or exceeded the price of 60 pounds of No. 2 Red Winter wheat at Chicago, in 1911–12, in 1914–15, and in 1917–18. Over the eighteen years the price of 60 pounds of No. 2 rye at Chicago was 81.1 per cent of the price of 60 pounds of No. 1 Northern Spring at Minneapolis, 85.1 per cent of the price of No. 2 Hard Winter at Kansas City, and 83.9 per cent of the price of No. 2 Red Winter wheat at Chicago. The relations in individual years are of course much wider, but judged by individual years as well as by the average, pound for pound, rye inclines to be worth something between three-fourths and five-sixths of the price of wheat.

For purposes of comparing the relative prices of rye and wheat, it is desirable to employ some common denominator, as the experienced grain trader unconsciously does in a rough way. Rye weighs less per bushel than wheat; and a pound of rye contains fewer calories than a pound of wheat. On the caloric basis, a bushel of wheat is equivalent to 1.06 bushels of rye. We have therefore recomputed terminal prices per bushel, so as to show terminal cash prices for one million calories of No. 2 rye at Chicago, compared with similar prices of No. 1 Northern Spring wheat at Minneapolis, No. 2 Hard Winter wheat at Kansas City, and No. 2 Red Winter wheat at Chicago.[3] Table 4 shows these prices for five pre-war and six post-war crop years.

Between 1914 and 1917 the practices of European grain buyers in the United States subjected prices to abnormal influences. Following the entrance of the United States into the war, allocations of wheat were made to mills. There were no allocations of rye corresponding to those of wheat, but European buyers of rye and rye flour could secure it only through governmental channels. Rye flour was for a time a compulsory purchase with wheat flour. After the close of the war, the Grain Corporation operated until May 1920, but wheat was not allocated to mills and rye was free. Because of these abnormal influences on both wheat and rye prices, we have omitted price data from July 1, 1914, to July 1, 1921.[4]

To revert to the statement that, other things being equal, the relative prices of the different grains depend partly on their energy values and partly on their special qualities, what ought one specifically to expect with the bread grains? As between wheat and rye, the larger amount of gluten and its superior quality in wheat would place the price of wheat above that of rye. The margin between wheat and rye ought

[1] In relation to size of crop, the exports of rye have exceeded those of any other grain.

[2] See Appendix Table X.

[3] Our computation is based upon the assumption of a 56-pound bushel for rye and a 60-pound bushel for wheat, and upon caloric values as per analyses of rye and wheat, as given in W. A. Henry and F. B. Morrison, *Feeds and Feeding* (Madison, Wisconsin, 1917). One million calories corresponds to 9.91 bushels of wheat of 60 pounds; and to 10.53 bushels of rye of 56 pounds. The procedure is not strictly accurate because caloric values vary slightly from variety to variety and from year to year. But the computed prices per million calories may be regarded as more satisfactory than the crude price data. The crude data appear in Appendix Table X. This table also shows rye prices converted to a basis of 60-pound bushels, approximately the conversion roughly followed by experienced traders in comparing rye and wheat prices.

[4] The crude data appear, however, in Appendix Table X.

to be substantial, expressing public preference for wheat bread over rye bread, but width of margin would not be unvarying. The two bread grains ought to stand apart from the coarse grains and on a higher price level, i.e., the commercial value of the gluten should bring a premium. Rye occupies a position between wheat and the coarse grains. It contains a gluten-like protein and therefore is a bread grain of the relatively high price of red winter wheat. The annual variations of both wheat and rye prices are to be explained mostly from the side of supply. The rye crop of 1913 (41.4 million bushels) was the largest of the period and the price the lowest; the rye crop of 1911 (33.1 million bushels) was the smallest of the period, and of poor quality, and the price the highest.[2] The wheat crop of 1913 was the largest crop of the

TABLE 4.—TERMINAL PRICES OF ONE MILLION CALORIES OF HARD SPRING, HARD WINTER, AND RED WINTER WHEAT, AND RYE, WITH RELATION OF RYE TO WHEAT PRICES, PRE-WAR AND POST-WAR*

Crop year July–June	Wheat			Rye	Relation of rye price to price of		
	No. 1 Northern Spring at Minneapolis (dollars)	No. 2 Hard Winter at Kansas City (dollars)	No. 2 Red Winter at Chicago (dollars)	No. 2 at Chicago (dollars)	No. 1 Northern Spring wheat (per cent)	No. 2 Hard Winter wheat (per cent)	No. 2 Red Winter wheat (per cent)
1909–10	10.80	10.60	10.90	8.00	74	75	73
1910–11	10.41	9.71	10.11	8.85	85	91	88
1911–12	10.60	9.61	8.92	9.58	90	100	107
1912–13	8.62	8.72	10.21	6.84	79	78	67
1913–14	8.72	8.52	8.72	6.74	77	81	77
Average	9.83	9.39	9.77	8.00	81	85	82
1921–22	14.17	11.50	12.39	10.21	72	89	82
1922–23	11.59	11.20	11.30	8.53	72	76	75
1923–24	11.59	10.41	10.11	7.37	64	71	73
1924–25	13.42	13.32	11.96	13.16	85	98	84
1925–26	15.96	16.15	16.25	10.11	63	63	62
1926–27	14.47	13.52	13.92	10.64	74	80	78
Average	13.92	12.74	13.23	10.00	72	79	76

* These prices are obtained by multiplying the cash sale prices (as given in the *Agriculture Yearbook, 1926*, pp. 819, 825, 836) by 3.81 in the case of wheat, 14.53 in the case of rye, the number of bushels represented by 1,000,000 calories.

strictly speaking; as such, it stands above the coarse grains for human consumption. But it is an inferior bread grain, and the per capita consumption is low.

Let us first consider the pre-war prices; it will suffice to confine our attention to the five crop years 1909–14.

Pre-War Prices

In the five years before the war, the terminal price of a million calories of wheat varied from $8.52 to $10.90, the average for the three types of wheat ranging from $9.39 to $9.83. The terminal price of a million calories of rye varied from $6.74 to $9.58, the average being $8.00. The year of lowest wheat prices was 1913–14, also the year of the lowest prices of rye. The year of the second lowest prices of rye, 1912–13, was also a year of low wheat prices, in spite of the relatively high price of red winter wheat. The annual variations of both wheat and rye prices are to be explained mostly from the side of supply. The rye crop of 1913 (41.4 million bushels) was the largest of the period and the price the lowest; the rye crop of 1911 (33.1 million bushels) was the smallest of the period, and of poor quality, and the price the highest.[2] The wheat crop of 1913 was the largest crop of the period, leading to the lowest price of the period and also presumably of influence in lowering the price of rye. The wheat crop of 1911, like the rye crop, was the smallest of the five pre-war years. The short crop of rye was accompanied by a higher price for rye, but the short crop of wheat was not accompanied by a relatively high price of wheat. The low price for the wheat crop of 1911 was due to a low world price, the result of conditions outside of the United States, which did not directly affect rye because we were practically on the domestic basis for rye.

It may be found suggestive to convert these figures into index numbers, using wheat as equaling 100; the index numbers appear in the last three columns of Table 4

[2] Though the amounts were trifling, it is significant to note that during the crop year 1911–12, imports of rye exceeded exports.

With the average unit price for each type of wheat taken as 100, the average pre-war index for rye was 81 per cent of hard spring wheat, 85 per cent of hard winter wheat, and 82 per cent of red winter wheat.

Table 5 contains a recomputation of farm prices of wheat and rye to the basis of one million calories of each grain.

TABLE 5.—PRODUCERS' PRICES OF ONE MILLION CALORIES OF WHEAT AND RYE, AND RELATION OF RYE PRICES TO WHEAT PRICES, PRE-WAR AND POST-WAR*

Crop year July–June	Wheat *(dollars)*	Rye *(dollars)*	Relation of rye price to wheat price *(per cent)*
1909-10	9.98	7.86	79
1910-11	9.09	7.73	85
1911-12	8.75	8.53	97
1912-13	8.26	7.23	88
1913-14	7.86	6.62	84
Average	8.79	7.59	86
1921-22	10.35	9.15	88
1922-23	9.71	7.17	74
1923-24	9.16	6.25	68
1924-25	12.66	10.14	80
1925-26	14.46	8.75	61
1926-27	12.17	8.87	73
Average	11.42	8.39	74

* These prices are obtained by multiplying the producers' prices (as given in the *Agriculture Yearbook, 1926*, pp. 818, 833), by 9.91 in the case of wheat and 10.53 in the case of rye, the number of bushels represented by 1,000,000 calories.

Comparing the two tables, one observes a general concordance. The year of highest terminal wheat price, 1909–10, was the year of highest farm price, and the year of lowest terminal wheat price, 1913–14, was the year of lowest farm price. But there was considerable fluctuation in the different years in the margins between terminal prices and farm prices. For rye, the year of highest terminal price, 1911–12, was the year of highest farm price; and the year of lowest terminal price, 1913–14, was the year of lowest farm price. Also with rye, the margins between terminal prices and farm prices varied from year to year. For the period, the terminal rye price was 82.8 per cent of the average of the three terminal wheat prices; the producers' price of rye was 86.3 per cent of the producers' price of all wheat.

For the purpose of the present study it suffices to note that the price of rye, judged by energy values, in averages of the five pre-war years, was somewhere between 81 and 86 per cent of the price of wheat, with rather wide variations in individual years. Even allowing for the fact that we were then heavy exporters of wheat, but not of rye, this difference expressed the superiority of wheat over rye (in gluten, color, odor, and taste) as a bread grain in the estimation of the American public; but the price differences were not the effect of consumers' preferences solely, since other factors certainly existed.

It would be interesting to compare representative European price indexes with the American, but it is difficult to secure comparable figures. The prices to be compared ought to be representative for representative products in representative countries. Prices in terminal markets in importing countries must be cautiously compared with those in exporting countries. The collection of price data here and abroad have not been done with identical methods. The grading of products has been different. The best method would be to use the prices of domestic products in the importing European country. In any event, such a comparison must remain somewhat arbitrary; but the results ought still to be suggestive.

A tentative computation[1] carried out with the prices of domestic wheat and rye on the Berlin market during the five years before the war has indicated that on the calorie basis rye was priced 79 to wheat 100. The rye on the Berlin market was probably above the average for the country, since the poorer rye was ground in smaller rural mills; the wheat, on the other hand, was probably no better than the average of the country.[2] If this inference be correct, the

[1] Data from M. Sering, *International Price Movements and the Condition of Agriculture in Non-Tropical Countries* (Berlin, 1927). The prices of the grains were in Berlin, in marks per thousand kilograms, for the calendar years 1909–13, requiring no correction for value of exchange since during this period the German mark fluctuated very little.

[2] Comparisons of rye and wheat prices in seven other German cities show that during the pre-war period rye prices were in no instance more than 81.9 per cent of wheat prices; the average relation for these cities was 80 per cent.

price of rye should have been high relative to wheat, rather than low. Possibly the explanation is to be found in the tariff. The tariff duty was the same for wheat and rye; but since Germany was a heavy net importer of wheat but a net exporter of rye, it seems reasonable to infer that the tariff was effective for wheat and not effective for rye, which would tend to make rye priced low relative to wheat. It may appear rather odd to find rye in Germany standing lower than rye in the United States in relation to wheat, since rye was a favorite bread grain in Germany. The explanation may possibly be found in the relative marginal costs of production.

Post-War Prices

From 1921 to date the prices of the several cereal grains have been rather topsy-turvy. This has been exaggerated by the fact that all five grains have been on the export basis more or less continuously, and the annual volumes of exports have in most years been heavier than during the years just preceding the war. The price of wheat was highest for the crop year 1925–26, next highest in 1924–25. The price of rye was highest for the crop year 1924–25, but only fourth highest in 1925–26.

The high price of wheat in 1924–25 was due to international rather than to domestic circumstances; but domestic influences were largely responsible for the high prices of 1925–26. In that year the United States was practically on a domestic basis for wheat but not for rye; the tariff on wheat was largely effective. The crop of 1923, the second shortest crop since the war, gave a low price. The largest crop of rye in our history, that of 1922, sold for a price considerably higher than that of the crop of 1923, which was only two-thirds as large. The crop of 1924, which sold for the highest prices since the war, was the second largest crop of the period; the crop of 1925, which was a small crop, sold for considerably less. While it is not possible to distribute the influences, it is reasonable to infer that the rather unusual behavior of the domestic rye price over the period was influenced not only by domestic supplies of rye, but also by domestic and world supplies of wheat. One gets the impression that, on account of the heavy volume of export of rye in proportion to the crop, the foreign price of rye has more influence than the domestic prices of wheat and coarse grains.

Of the record rye crop, 103 million bushels in 1922, over 52 million bushels were exported. The rye crops of 1923 and 1924 were 63 and 65 million bushels respectively. Of the 63 million bushel crop in 1923, 20 million bushels were exported; against the 65 million bushel crop in 1924, stood an export during the crop year of no less than 50 million bushels.[1] The large export during 1924–25 was at the highest price of the period, the small export during 1923–24 was at the lowest price of the period.

Turning now to the price indexes, one observes that the indexes of rye, relative to wheat, have tended to be lower since the war than before the war. The average relation of the price of rye to the price of hard spring wheat before the war was 81 per cent, the highest was 90, and the lowest was 74; the average relation since the war was 72 per cent, the highest 85, and the lowest 63. The average relation of the rye price to the price of hard winter wheat before the war was 85, the highest 100, and the lowest 75; the average relation since the war was 79, the highest 98, and the lowest 63. The average relation of the price of rye to the price of soft red winter wheat before the war was 82, the highest 107, and the lowest 67; the average relation since the war was 76, the highest 84, and the lowest 62. The average for the five years before the war was made rather high for rye by the exceptional year 1911–12; also, the average for the period since the war has been made somewhat low for rye by exceptional wheat prices during 1925–26. On the entire record, rye since the war has been worth less, relative to wheat, than before the war. Over most of the period since the war the trading forces have pulled together for wheat and rye, though occasionally they have pulled apart, usually to the advantage of wheat but sometimes to the advantage of rye, if one were to judge directly.

Despite the unsatisfactory nature of price quotations in Germany since the war, we have attempted a comparison of prices of

[1] Obviously, some of the rye exported had been carried over from the previous crop.

wheat and rye, using Berlin quotations. The lowest position of rye was in 1923–24, when the price of rye was 77 per cent of the price of wheat. The highest position was in 1924–25, when the price of rye was 87 per cent of the price of wheat. The average for the six years was 84 per cent. If the post-war comparisons are comparable with the pre-war comparisons, rye has been relatively higher since the war than before. In the United States, the average price of rye was some 83 per cent of the average price of wheat before the war and 74 per cent since the war. In Germany, the average price of rye was 79 per cent of the price of wheat before the war and 84 per cent since the war. While rye has depreciated in the United States, it has appreciated in Germany, relative to wheat. We have no entirely satisfactory explanation of the trend in the German figures. It may be mentioned, however, that Germany before the war was a net importer of wheat but not rye, while since the war she has been a net importer of both commodities, with tariff protection in both periods. Furthermore, the situation may have been influenced by the fact that, while production both of wheat and rye has declined in western Europe, the lesser decline in wheat has apparently been more than offset by increases in wheat production elsewhere in the world, whereas the greater decline in rye perhaps has not, or at least not so completely. In any event, it is obvious that the closer the price of rye approaches the price of wheat in Germany, the more incentive to import wheat rather than rye.

The Prices of Wheat and Rye Flour

It is easy to make arbitrary comparisons of wheat and rye flour prices; it is less easy to make interpretations. In so far as there may be a relationship between the mill-door prices of wheat and rye, if the returns on millfeed, the expenses of operations, the overhead, and the costs of selling were identical or comparable, the wholesale prices of wheat and rye flours ought to stand a certain distance apart, but show the same trends. But the stipulations do not hold. Purchase of rye and sale of rye flour are not so routinely protected by hedging as those of wheat. The miller of rye is not confronted with premiums for protein as is the miller of wheat. Since rye is ground in smaller mills than wheat, the relations to capacity output are different. Rye flour is little advertised and the cost of selling is less. The fraction of flour secured from the unit of rye is lower than from the unit of wheat; therefore, the price of millfeed is more important. These several circumstances impair the usefulness of direct price comparisons.

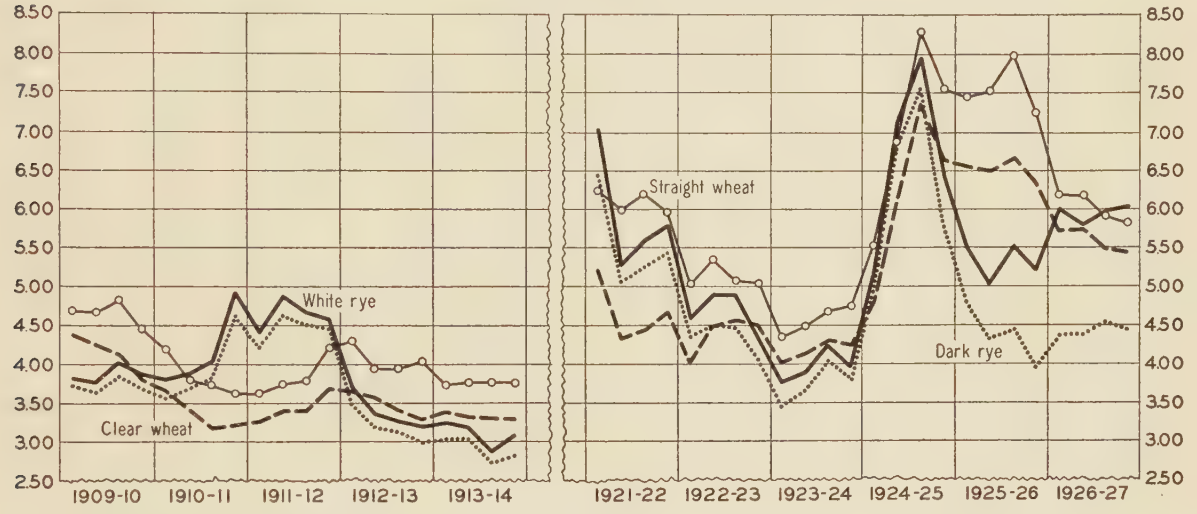
There is little purpose in comparing rye and wheat flours according to names, for example, patent wheat flour with patent rye flour, since the flours have different uses and are not interchangeable. The wheat flours whose prices ought to be compared with those of rye are the flours that are, to some extent at least, interchangeable with rye flour, with which the rye flours are substitutive, with which they are commonly mixed. The proportions of wheat and rye flours in a so-called rye blend depend upon the prices and the qualities in a particular season. In the rye blends one finds mostly clear and straight wheat flour, but little patent, even of the cheapest. For the most part, the question of price is in the mind of the baker, not of the bread buyer. Therefore, the most useful price comparisons would apply to the wheat and rye flours that compete, are mixed together, are substitutive in making rye bread.

In this country rye flour is not used to stretch or dilute wheat flour; rather, wheat flour is used to strengthen and improve rye flour. A comparison of prices of wheat and rye flours must be based upon this consideration. There may be circumstances under which a rye blend would be prepared with the cheapest wheat flour and the cheapest rye flour; possibly also occasions when a high-priced patent wheat flour would be used with the highest-priced rye flour. But a blend of high-grade rye flour with a lower-grade wheat flour will usually give a better blend for the American public than one of higher-grade wheat flour with low-grade rye flour. Under these circumstances, the baker of rye bread, in choosing a wheat flour for his rye blend, would naturally choose the cheapest wheat flour. He would compare it with the dearest rye flour. The highest-priced rye flours are the most representative rye flours. These we compare not with the highest-priced wheat flours, with

which rye flours do not come into contact, but with the low-priced wheat flours with which rye does come into contact. The price series that follow, therefore, contain the top prices for white rye and dark rye respectively and the bottom prices for the straight and first clear wheat flours. The four Chicago flour prices compared over the intervals under consideration are (1) the cheapest straight wheat flour (hard spring, hard winter, or red winter); (2) the cheapest first clear wheat flour (hard spring, hard winter, or red winter); (3) the dearest white rye flour (a short patent); and (4) the dearest dark rye flour (a straight or a long patent). Chart 2, based upon quarterly averages of weekly quotations, shows these comparisons.

CHART 2.—QUARTERLY PRICES OF RYE FLOUR AND WHEAT FLOUR AT CHICAGO, 1909–14 AND 1921–27*

(Dollars per barrel)



* For data see Appendix Table XII.

The price of white rye flour, a patent, is of course always higher than the price of dark rye, a straight flour; but the margin varies from year to year and even from month to month, and tends to be wider when the price level is high. Straight wheat flour is a higher-priced product than first clear wheat flour; but the margin varies from year to year and even from month to month. What seems to be the most frequent relationship between rye flour and wheat flour is for white rye flour to be priced in the neighborhood of first clear wheat flour. At times, white rye flour may be definitely cheaper than the first clear wheat flour; on the other hand, white rye flour is often priced above first clear wheat flour. Beyond that, white rye flour may be priced with straight wheat flour, rather than with clear wheat flour, sometimes even above it. Finally, under exceptional circumstances, white rye flour may be priced with high-grade patent wheat flours.

Whatever the price relation of white rye flour to wheat flours, dark rye flour lags a varying distance behind white rye flour, depending somewhat on the rate of extraction. Also, rye millfeed is priced lower than wheat millfeed, on account of lower protein and higher fiber content.

During the crop year 1909–10, white rye flour was quoted almost consistently below the price of the cheapest first clear wheat flour, and did not approach the level of the cheapest straight wheat flour. Occasionally, the difference was nearly a dollar a barrel; in many weeks it was 50 cents; sometimes it was only 10 cents; but in several weeks, toward the close of the crop year, the top price of white rye flour exceeded the price of the cheapest first clear wheat flour. At the closest, the price of white rye flour stood 35 cents below the price of the cheapest straight wheat flour.

During the crop year 1910–11, the prices of rye flours tended to be relatively higher. For the most part, the top price of white rye flour was definitely above the price of

the cheapest first clear wheat flour; indeed, the top price of dark rye flour was usually above the price of the cheapest first clear wheat flour. During over half of the year, the top price of white rye flour exceeded the price of the cheapest straight wheat flour; toward the close of the year, the top price of dark rye flour also exceeded the price of the cheapest straight wheat flour. Finally, toward the close of the crop year, the top prices of both white and dark rye flours stood considerably above the price of the cheapest patent wheat flour.

During the crop year 1911–12, the prices of rye flours were consistently high, relative to wheat flours. Dark rye flour stood above first clear wheat flour, usually above straight wheat flour, and often above the cheapest standard patent wheat flour. White rye flour stood almost consistently above the cheapest standard patent wheat flour.

During the crop year 1912–13, the price relations reverted to the earlier position. The top price of white rye flour stood near the price of the cheapest first clear wheat flour a little above or below, with dark rye lagging behind. Not once during the year did the top price of white rye flour approach that of the cheapest straight wheat flour, and the difference was frequently almost a dollar a barrel.

During the crop year 1913–14, the same relations were again in effect. The top price of white rye flour stood a little below that of the cheapest first clear wheat flour, with dark rye lagging behind. The price of the cheapest straight wheat flour ranged from 35 cents to 95 cents per barrel over that of white rye flour.

Over the five-year period the average prices for the four flours ranged as follows:

Straight wheat flour	$4.02
White rye flour	3.82
Dark rye flour	3.62
First clear wheat flour	3.55

If one regards the prices during 1910–12 as unusual, averages for the other three years, regarded as the more usual, would be as follows:

Straight wheat flour	$4.15
First clear wheat flour	3.64
White rye flour	3.44
Dark rye flour	3.25

If the step-like relationship between the prices of straight wheat, first clear wheat, white rye, and dark rye flours is to be regarded as the more usual, what explanation is to be offered for the crop years 1910–12, when the prices of rye flour stood relatively much higher? The explanation lies directly at hand. The wheat crops of 1910 and 1911 were rather small, but were normal for the country on the export basis. The rye crops of 1910 and 1911 were somewhat short. Also, the quality of the rye was below normal in these two years. The prices of the wheat and rye flours reflected the prices of wheat and rye. The average cash Chicago price for No. 2 rye for the 1911 crop, 91 cents, was by far the highest of the five-year period; the price of the 1910 crop was 84 cents; but the prices during the other three years were 76, 65, and 64 cents. It was not that wheat prices were down out of line, but that rye prices were up out of line, and substantially so. A somewhat short crop of rye, of unsatisfactory quality, a short crop of corn, relatively more rye fed on farms and less sent to market, low primary receipts, small visible supplies, with millers seeking 12 million bushels and distillers seeking 5 million bushels — naturally the price of rye rose in 1911–12 relative to that of wheat.

The figures illustrate again the familiar experience that shortage of a naturally low-price crop may drive its price above that of a naturally high-price crop. Considering the aversion of Americans to dark rye bread, it is surprising enough to witness dark rye flour selling for more not only than straight and first clear wheat flour, but also than standard patent flour made of soft red winter wheat. It is little less than astonishing to learn that dark rye flour has occasionally been quoted in Chicago up to standard patent flour made of hard wheat. All of which merely proves that despite the general low esteem in which rye bread is held, with those who prefer it, the demand must be relatively inelastic.

During 1921–22 the top price of white rye flour was always above that of first clear wheat flour and often far above it. The top price of dark rye flour was always above the price of the cheapest first clear wheat flour, sometimes over a dollar above it. The top price of white rye flour was above the

price of the cheapest straight wheat flour early in the season, and was a few times as high as that of standard patent wheat flour. The top price of dark rye flour was sometimes above that of straight wheat flour.

During 1922–23 the top price of white rye flour was usually above the price of the cheapest first clear wheat flour, also sometimes equaling and even exceeding the price of the cheapest straight wheat flour. The top price of dark rye flour was often as high as that of first clear wheat flour, but never as high as that of straight wheat flour.

During 1923–26 there were three successive years of closely corresponding price relations. The top price of white rye flour was near that of first clear wheat flour, usually a little below it, sometimes below it by more than a dollar a barrel, but quite often above it. The top price of white rye flour equaled the price of the cheapest straight wheat flour in only a few weeks during the three years, was usually definitely below it, and sometimes stood by more than $2.00 below it. The top price of dark rye flour was only occasionally as high as the price of the cheapest clear wheat flour, rarely above it except in 1924–25, and was often below it by more than $2.00 a barrel.

During 1926–27, the price of white rye flour exhibited a somewhat unusual behavior. In the first week of the season the order of prices was in the usual sequence—straight wheat flour, clear wheat flour, white rye flour, and dark rye flour. Then the price of white rye flour rose relative to the others, and throughout the year, with the exception of a few weeks, the top price stood above the price of the cheapest first clear wheat flour, and indeed in several weeks in the last half of the year stood above the price of straight wheat flour, once by as much as 60 cents a barrel. The price of dark rye flour, however, did not advance in the same way and remained low. On the average, over the season, the top price of white rye flour was but little behind that of straight wheat flour, considerably above that of first clear wheat flour, and around $1.50 a barrel above that of dark rye flour.

What ought to be regarded as the usual relationship between the prices of straight wheat, first clear wheat, white rye, and dark rye flours is as much a question of judgment as of statistics. Certainly, a classification should not rest merely upon a bare average covering a number of years. It is necessary to contrast years within the period. We have surveyed the prices for five years before the war and six years since the war. On the basis of the averages for the several years, the positions may be summarized as follows:

	Highest price	Second price	Third price	Lowest price
Wheat, straight..	9	0	2	0
Wheat, clear....	0	5	2	4
Rye, white	2	4	5	0
Rye, dark.....	0	2	2	7

In considering just what is to be regarded as usual, several considerations must be held in mind: first, the prices used for straight and clear wheat flours were always the lowest of the three (hard spring, hard winter, and red winter) while the top prices were used for the rye flours; secondly, several times the price of rye has been high enough relative to wheat to make the calorie price for rye flour equal to or above that of wheat flour, which may reasonably be regarded as abnormal, in view of the gluten superiority of wheat flour. Also, Chicago is the market in which rye flour reaches its relatively highest price, since it is in the midst of the heavy rye-consuming region. With these qualifications in mind, it seems reasonable to regard the following order of prices as usual:

Straight wheat flour
First clear wheat flour
Patent rye flour
Straight rye flour

An exchange of positions between clear wheat flour and patent rye flour occurs so frequently that one cannot term it abnormal, since clear wheat flour was second or better five times while white rye flour was second or better six times. From present indications, the price of white rye flour will be above that of clear wheat flour during the crop year 1927–28.

Using the prices over the eleven years (five pre-war and six post-war), with the average price of straight wheat flour taken as 100, the average price of first clear wheat flour was 87.2, that of white rye flour 91.2, and that of dark rye flour 82.7. On this rating, white rye flour would rank ahead of first clear wheat flour. Rating the two by weeks of leadership, it would appear that

during the eleven years the price of first clear wheat flour stood above that of white rye flour in 44 per cent of the weeks. While we are inclined to regard it as the more usual relation to have first clear wheat flour stand above white rye flour, the point is not important enough to warrant involved discussion. It is enough to have it made clear that patent rye flour and first clear wheat flour have roughly the same price relations and are the usual components of blended flour in the United States.

Judged on the calorie basis, the price of white rye flour usually approximates that of first clear wheat flour. But if one were purchasing these flours on protein analysis, as concentrates are purchased for feeding, the rye flour would be substantially overpriced. White rye flour has the lowest protein content of any rye flour; first clear wheat flour has a high protein content for wheat flour, more than patent or straight. Not only does the first clear wheat flour contain substantially more protein than white rye flour, but this protein stands higher in gluten behavior than the protein of the rye flour. While white rye flour cannot be regarded as overpriced on the basis of calories, the price cannot be explained by the protein content. The only attribute of rye flour to which this price can be attributed lies in the flavor.

Further Comparisons of Flour Prices

It may be of some interest to contrast the prices of wheat and rye flours that are comparable from the milling standpoint. Pertinent figures for pre-war and post-war years are as follows:[1]

Year July–June	Wheat patent flour *(dollars)*	Rye patent flour *(dollars)*	Relation of rye to wheat *(per cent)*
1909-10	5.15	3.86	75
1910-11	4.42	4.15	94
1911-12	4.49	4.63	103
1912-13	4.44	3.37	76
1913-14	4.26	3.09	73
1921-22	6.74	5.94	88
1922-23	6.15	4.67	76
1923-24	5.51	3.96	72
1924-25	8.03	6.67	83
1925-26	8.56	5.32	62
1926-27	7.01	5.94	85

The patent wheat flours selected for price comparison with patent rye flours corresponded to first patent. These patent flours before the war were not strictly comparable with those after the war; also, the patent rye flours are not strictly comparable. The rye price was the highest quotation for "rye flour, white, jute." "First patent, Kansas, jute" and "spring wheat patent, jute" represented the hard wheats; "patent, southern, jute" represented soft winter wheat.

For the period since the war, the quotation for rye is for "rye flour, white." "Spring first patent" and "hard winter short patent" represented the hard wheats and "soft winter short patent" represented soft winter wheat. In both periods, the highest quotation of patent rye is contrasted with the highest quotation of the cheapest first patent wheat flour on the Chicago market.

In looking over the flour prices from week to week and the averages from quarter to quarter, one observes rather notable fluctuations, whereby the margin between wheat and rye patent flours is widened or narrowed. Usually patent spring wheat flour stands above the others in Chicago; the lowest-priced variety is either hard or soft winter wheat.

In three of the five pre-war years the average price of patent rye flour stood close to three-fourths of the average price of patent wheat flour. During 1911–12 the average top price of patent rye flour stood above the average top price of patent wheat flour of the cheapest variety of wheat.

When the prices for the year 1911–12 are scrutinized in more detail, one obtains the following relation. The highest price of the year was spring patent, with an average price of $5.05, of which the rye flour price of $4.63 was 92 per cent. The average price of first patent hard winter wheat flour was $4.99, of which the rye flour price of $4.63 was 93 per cent. The average price of patent soft red winter wheat flour was $4.51 of which the rye price of $4.63 was 103 per cent. The price of patent rye flour was high relative to the prices of patent flours of all varieties of wheat, but particularly high compared with soft winter patent flour, because soft red winter wheat during this season stood relatively low compared with the hard wheats.

[1] Chicago quotations, compiled from the *Northwestern Miller.*

Since the war, the relations between the prices of patent rye and wheat flours have fluctuated much after the same fashion as before the war; but the comparisons are more trustworthy since the war because the flour grades have been more uniform. The highest position occupied by rye since the war was during the year 1921–22, when the price of rye flour was 88 per cent of the price of wheat flour. The lowest position was during 1925–26, when the top price of patent rye flour was only 62 per cent of the top price of first patent wheat flour of the cheapest variety. This was the crop year of short wheat crop and poor quality, when the country was on a domestic basis (practically speaking) and millers had to search about for wheats with which to mill flours up to their accustomed standards. The rye crop was normal and mills had no difficulty in finding rye to grind to patent rye flour up to their accustomed standards. Of course, no one can say what the price of rye flour would have been if the wheat crop had been normal, but it seems clear that the high price of patent wheat flour exerted little influence in drawing up the price of patent rye flour, this confirming the general experience that rye flour is not used as a substitute for wheat flour in bakery or kitchen in this country.

Averages over short periods mean little, but for whatever meaning they have it may be observed that the average price relationship, during the five pre-war years, of the top patent rye flour to the top first patent wheat flour of the cheapest wheat variety was 84 per cent, a figure somewhat too high to represent customary relations on account of the year 1911–12. The average price relationship during the past six crop years of the top patent rye flour to the top first patent wheat flour of the cheapest wheat variety was 77 per cent, a figure somewhat too low on account of the crop year 1925–26. The only significant inference to be drawn is that patent rye flour tends to stand at a somewhat heavier discount below patent wheat flour since the war. This may reasonably be attributed in part to improvement in first patent wheat flour, associated with shorter extraction.

It is tempting to contrast the margins between rye and the wheats with those between patent rye flour and the patent wheat flours. If we had comparable material over a long term of years, something positive might come out of such a comparison. But over a short period bias is introduced into such a comparison because of the influence of protein premiums on the prices of patent wheat flours. To secure wheat prices comparable with flour prices, one would need to know not the average prices of wheats by grades, but the average mill prices of wheats as actually purchased, representing in different years various increases over the grade prices to correspond to premiums on protein. Out of official figures there is no way of weighting the influence of premium on protein from year to year. Where premiums on protein are low, then the margin between rye and wheat flour prices ought to correspond roughly to the margin between rye and wheat, other things being equal. Where the premiums on protein are high, the margin between rye patent and wheat patent flour would necessarily be much wider.

Prices of Wheat and Rye Breads

Comparisons between prices of wheat and rye breads would be interesting and instructive, but they are impracticable. We have nowhere been able to find a series of trustworthy rye bread prices that could be compared with those of wheat bread. The Department of Labor reports prices of neither rye flour nor rye bread. Local figures are available since the war, but these would not serve the purpose desired. Rye bread is made of cheaper flour, contains few ingredients outside of flour, the processes of manufacture are simpler, the costs of delivery are lower, there is less stale bread loss, and the cost of selling is lower. Rye bread is not wrapped as a rule; it is advertised little; the separate expense of delivery is lower than for wheat bread. It seems natural to make the inference that rye bread is made and merchandised on a narrower margin than holds in the case of wheat bread. The accounts of bakeries making both kinds of bread would doubtless reveal interesting comparisons, but these are not available to us. For the most part, rye bread does not appeal to poorer classes on the basis of price. It does not hold to wheat bread a relation comparable

to that which shoulder holds to ham. For most people in all income classes, rye bread is different from wheat bread and appeals to its own clientele for reasons that lie largely outside of price under most conditions. Even under these circumstances, one has the right to infer not merely that rye bread is cheaper than wheat bread pound for pound, but that the margin between rye grain and rye bread is narrower than between wheat grain and wheat bread. How much narrower we are unable to show.

Before the war it was common custom in Europe to sell the pound of bread for the price of the pound of flour. This of course held only for the common types of bread, but applied to both wheat and rye. The baker, using only water, salt, and yeast in addition to flour, was supposed to have labor costs and profits covered by the increased outturn of bread in terms of pounds. Since the war, whenever public bodies undertake to control the retail price of bread in Europe, they incline to apply the pre-war rule with stipulation for standard price of flour. But the bakers who were able to conduct their business according to this rule before the war are apparently unable to do so since the war, labor costs having increased. The continued social importance of the retail price of bread in Europe is illustrated by the attention being given to the price of flour and bread, ten years after the close of the war, by the Food Council of Great Britain. Of all the hangovers of the war, controls of price of bread and of rent remain the longest and will be the most difficult of disposition.

V. PROSPECTS FOR USE AND PRODUCTION OF RYE

Substitutions for Rye and by Rye in Europe

The substitution of rye for and by wheat and the coarse grains and potatoes is important in Europe, but adequate statistical data are wanting. Certain general observations, however, may be ventured. Four sets of circumstances are involved: (1) customary crop relations in Europe; (2) the customary disposition of the crop; (3) relative prices of the several grains and potato; (4) state of business, income, and purchasing power.

With respect to the customary relations between the crops of cereals, conditions before the war in Europe were relatively immovable and are tending to become so again. For most European countries, favorable systems of crop rotation had been worked out and these rotations were not lightly disrupted either by large landlord or peasant. These rotations were in large part the expression of limiting factors in disposition. Fluctuations in domestic supplies were largely the result of variations in yields, not in acreages. A higher or lower price for a particular cereal had little effect upon the acreage of the following year. In short, for the most part, adaptation on the side of supply was hardly practicable in Europe, so far as the supply represented domestic production.

Fluctuations in the prices of substitutive products, if not notable in causing variations of domestic supplies, were significant with respect to utilization. As a continent, Europe endeavored to judge cereals and potatoes on the basis of price per calorie. This was particularly true of the coarse grains. Rye stood in between, with wheat above, the coarse grains below. From the most select use of wheat to the lowest use of potato, was a series of overlapping uses.

Just as crop rotations were highly developed and fairly fixed in most countries, so the dispositions between human beings, animals, and industries were well established in each country, partly on the basis of price directly, but partly on the basis of established animal husbandry. These relations were necessarily subjected to control during the late war, since the warring countries, under blockade, could not afford to use high-cost cereals for low-value purposes. Germany may be cited in illustration. According to the Eltzbacher Commission, the customary pre-war disposition of the domestic crops, after subtraction of seed, was about as follows, in percentages:

	Food use	Animals and industry
Wheat	90	10
Rye	75	25
Potato	30	70
Barley	15	85
Oats	5	95

The scope for adaptation is clearly revealed in the figures, which, with variations from year to year and from country to country, may be regarded as illustrative for the northern and central portions of Europe. As between use by animals and by industries, very little of the wheat went to industries; possibly a third of the 25 per cent of rye went to industries; a large part of the barley went to industries (depending on the prominence of brewing in the particular country); practically none of the oats went to industries; while industries used from a fourth to a half of the 70 per cent of potatoes.

Economic conditions in Europe presumably determine to some extent the effective demand for foodstuffs. With high employment, the per capita intake tends to be increased; with low employment, some reduction would be observed. The income of the urban working classes is so close to the level of minimum needs that retrenchment and expansion in subsistence occur with changes in income. The proportion of income expended for food in Europe is relatively high; but the amount in absolute terms of gold is relatively low, especially by comparison with the United States and Canada. With prosperity, the proportion of the income so expended is likely to be increased, and the absolute amount is certain to be increased. During hard times, the absolute outlay may be reduced, but the proportion of the family income expended for foodstuffs may be increased. The most important items in the cost of living of the urban working classes of Europe are bread and rent. Bread is the staff of life everywhere in Europe, even in England where the per capita consumption of animal products is high. Upon the bread staff everyone leans more or less, but most of all during hard times. Nevertheless, fluctuations in income presumably affect per capita consumption of cereals but slightly. Fluctuations in income probably affect not so much the absolute intake of cereals and potatoes as the relative amounts of each. It is impossible to prove these inferences, but they are well supported by observation.

Other things being equal, certain amounts of wheat, rye, barley, oats, corn, and potato are regarded as appropriate in the diets of different classes in different countries. With increase of income, with prosperity, the use of wheat tends to be expanded, replacing rye, in some classes; in others, the use of rye tends to be expanded, replacing coarse grains and potatoes. During hard times, the use of wheat tends to be curtailed in some classes, to be replaced by rye; in other classes, the use of rye tends to be curtailed, to be replaced by coarse grains and especially potatoes. The net result may be nil for rye, but a gain or loss for wheat and a gain or loss for potato. Or the net result may also be a gain or loss for rye. The adaptations and substitutions vary from country to country, in accordance with the crops of wheat, rye, coarse grains, and potatoes respectively. In human consumption, wheat tends to impinge on rye; in animal consumption, coarse grains and oil seed concentrates tend to impinge on rye. It is at present practically impossible to measure the extent of these substitutions, either in Europe as a whole or in particular countries. But the facts are a commonplace to the trade.

At no time during the past seven years has Europe imported all the wheat and rye available throughout the world. In every year there has been some short shifting in Europe, varying from country to country and from season to season. If the average supply of wheat, rye, and potatoes has been higher since the war (adjusted for population), that means little because animal husbandry has been upon a lower level. Year after year, back-and-forth substitutions and adaptations occur, and appreciation of these movements is of great importance to the trade in judging European requirements for imported wheat and rye in any season. Also, from this standpoint does the trade try to judge of the demand for rye in place of wheat or of wheat in place of rye.

Potatoes in Europe and the United States

It may not be out of place here to draw a contrast between the relations of the potato to bread grains in the United States and in Europe. Despite the preponderance of North European stock in our population, we lack the predilection of our forebears for potato. In Germany, rye, wheat, and potato form the bulk of the national ration,

contributing over 50 per cent of the total calories of the national dietary; in the United States, wheat, rye, and potatoes contribute less than 30 per cent of the calories of the national dietary. In northern Europe the potato is pre-eminently a calorie-carrying food; in the United States the potato is one of the fresh vegetables. The larger average gold income in the United States, the smaller proportion of the average income expended for foodstuffs, the trend toward diversification of the diet and latitude in the selection of the diet, all make for greater adaptability of food supply in the United States than in Europe. In Europe, north of the latitude of the Alps, the potato goes into three uses—foodstuffs, feeding stuffs, and industrial raw materials. In each direction it may act as substitute and may also be substituted on the basis of price. When potatoes are cheap, less wheat and rye are consumed; when potatoes are dear, more wheat and rye are consumed. Demand is elastic in both directions.

The relations of the potato are best known for Germany, though generally applicable to other countries in northern Europe. Potato crops in Germany vary from 25 to 45 million tons; in each decade they count on one crop failure (below 30 million tons) and on two bumper crops (over 40 million tons). The customary use for seed, food, and industries, including the usual waste, is around 20 million tons. If less than 10 million tons are available for feeding stuffs, substitutes must be procured. With large crops, the excess must be used for human food (largely replacing rye) or for animal feed (replacing rye and other grains that can be carried over), dried and carried over into the next crop year, or wasted. The problem of finding a use for too many potatoes comes oftener than the problem of finding substitutes when there are too few. As better-yielding varieties are developed, the problem of the potato surplus is accentuated in Germany.

In the United States the potato is raised almost entirely as human foodstuff. The feeding uses of potato are scarcely more than incidental to the salvage of an excessive crop. We have practically no distillation of potato, and little fabrication into starch or other industrial use. Under these circumstances, variations in yield have a heavier influence on price than is the case in Europe. People tend to consume a certain amount of potato in connection with other vegetables. When potatoes are cheap, consumption is not notably stimulated, and but few people eat more potatoes and less bread. When the crop is short and price is high, consumption is not seriously curtailed. For the small amount of potato the average American uses, consumption is maintained, with that of other vegetables, in about the same proportion. Indeed, one of the striking facts in potato consumption in this country is the insistence on continued use in the customary, though limited, place in the diet, despite high prices. There have been times when raw potatoes cost more per pound than flour, under which circumstances, considering the waste of potatoes, the price per calorie has been not far below ten times as much as the price per calorie in flour.[1] Such prices were procurable only because consumers insisted that potatoes, as a vegetable, be served with certain other foodstuffs, especially meat, quite irrespective of cost.

In summary, the potato in Europe occupies a broad position in the diet, supplementing bread grains; in the United States the potato occupies a narrow position in the diet, and is one of the fresh vegetables. In Europe, consumption expands with lower prices and contracts with higher prices; in the United States, consumption expands little with lower prices and contracts little with higher prices. In particular, the average American does not regard the potato as a substitute for wheat or rye.

Prospect for Rye

The prospect for rye in the near future in the United States would seem to depend on expansion of use as feeding stuff. There is little reason to expect the human per capita consumption of rye bread to increase

[1] It is astonishing enough, from the standpoint of calories, to observe that, according to the United States Department of Agriculture, in three of the past six years, the farm price of potatoes per pound has been higher than the farm prices of wheat and rye—with potatoes containing 80 per cent of water and the bread grains less than 15 per cent! Considered nutritionally, some of these prices touch absurdity. Thus, in 1925, the producers' price of rye was reported as 83 cents and of potatoes 186 cents, making potatoes practically ten times as expensive as rye at the farm door, in terms of nutrient value.

unless use of rye bread for sake of variety expands notably. On the contrary, with continuation of restriction on immigration and the acquisition of the wheat-bread habit by the second generation of immigrants, the per capita consumption of rye bread may decline. Notable expansion in the use of rye "health bread" is hardly to be expected.[1] There is no prospect for revival of use of rye in distillation, and no other industrial uses of moment are in sight.

As pointed out, the agricultural advantages of raising rye are several. It fits well into diversified agriculture, alike in the relations to soil, climate, farm labor, crop rotation, and fodder use. These advantages are, in one way or another, quite as prominent in southern and western states as in the states adjacent to the Great Lakes. The position of rye depends on the cash price of rye as an income crop or the product price of rye as a feeding stuff, in competition with the coarse grains. In terms of calories, oats are over-priced in comparison with rye. In connection with the declining numbers of work animals (to which oats are regarded as peculiarly adaptable, since the bulk of the hulls protects against gorging), it is possible that rye might fall heir to some of the embarrassed oat acreage if farmers generally would learn to employ rye effectively in mixed-grain rations. The rye acreages harvested in 1913 and 1914 were practically identical, at 2.5 million acres. The acreage of 1926 was nearly 3.6 million acres, while the acreage of 1927 was nearly 3.7 million acres. Rye acreage has declined from the peak of 1922, 6.7 million, to a point scarcely more than a million acres above the prewar level. Whether this acreage will be maintained remains to be seen; but the trend is hardly a matter of immediate importance. One million acres of rye is a third of the total in rye and therefore a large percentage; but it is practically negligible in the gross cereal acreage of the United States.

It would hardly seem that European demand for American rye holds out worthwhile prospect to American farmers. If we were able to offer Europe a bread rye of high type, a limited market might continue available in Europe, pending recovery of Russian exports. European purchases of American rye since the war have represented little else than a phase of post-war recovery. In each year since the war additional rye could have been purchased in the United States at prices below the equivalent prices of wheat; but it was not wanted. Even more than before the war, despite the poverty of Europe, wheat is preferred to rye; when rye is preferred, American rye is the least sought. The export of the crop year 1926–27 was over 21 million bushels, corresponding roughly to the outturn of nearly two million acres. It is not known whether or not this export has been remunerative to growers. It is difficult to expect this level of exports to be maintained during the next few years. The rye exports of the present season are heavy, but it cannot be lightly assumed that this level of exports will be maintained in coming years. The current exports of rye, and of barley, are in part related to a short crop of corn and mediocre crops of rye, barley, and oats, and to the high count of livestock in western Europe. Except in years of crop failure abroad, therefore, European demand for American rye cannot be counted on. This situation creates a problem for the Dakotas in their rye and durum wheat acreage; if not planted to rye and durum wheat, to what use shall this acreage be put? American farmers, however, can hardly maintain a rye acreage in expectation of crop failure abroad.

The international position of rye would seem to be readily appraisable. In Europe and Russia, established ideas on rotations will tend to keep rye and wheat acreages in the same relative position they occupied before the war. Let us assume for the near future the recovery of Russian agriculture, in so far as it involves wheat and rye. European cereal agriculture may be regarded as already restored. The war expansions of rye acreage tend everywhere to recede; the war expansions of wheat acreage tend, outside of the United States, to be maintained. Per capita consumption of wheat in the world is increasing, and the wheat-consuming population is growing. So long as good new wheat land is available in Canada, Ar-

[1] To the extent that effective demand for graham bread represents a craving for roughage, rye bread ought to be preferred to wheat bread, since rye bran is less digestible than wheat bran.

gentina, Australia, and elsewhere, the expanding world demand for bread grain will be satisfied without invoking the tillage of new rye land. In Canada, in Argentina and other South American states, in Australia, in South Africa, and in Manchuria and Mongolia are extensive regions better adapted to rye than to wheat. But so long as new wheat lands are still available there, these will have first call. Possibly for many decades, wheat culture in the world will keep abreast of world demand for bread grain. Later it is reasonable to expect that the potential rye lands of the world—what might be called the second line of bread-grain defenses—will be brought into operation. How long one expects this to be deferred, depends upon one's notion of population growth of the world. But it will not be soon.

This study has been written by Alonzo E. Taylor, with the aid of Elizabeth M. Brand and the assistance of the Institute staff

APPENDIX

TABLE I.—RYE ACREAGE, PRODUCTION, AND YIELD PER ACRE IN PRINCIPAL EUROPEAN PRODUCING AREAS, AVERAGE, 1909–13, AND ANNUALLY, 1920–27*

A.—ACREAGE

(Thousand acres)

Year	Hungary	Other Balkans[a]	Russia[b]	France	Germany	Belgium and Netherlands[c]	Scandinavia[d]	Spain and Portugal	Czecho-Slovakia	Poland	Austria	Baltic States[e]	Others[f]
Average 1909–13	1,608	2,560	61,055	3,095	12,713	1,255	1,650	2,259	2,605	12,127	1,110	3,712	482
1920	1,475	1,733	.....	2,148	10,589	1,034	1,510	2,331	2,238	7,236	714	2,640	405[g]
1921	1,341	1,722	.....	2,227	10,539	1,079	1,508	2,359	2,181	8,866	758	2,745	384[g,h]
1922	1,663	1,588	.....	2,195	10,236	1,051	1,449	2,347	2,174	11,225	834	2,931	368[h]
1923	1,620	1,555	.....	2,215	10,790	1,112	1,470	2,351	2,123	11,477	922	3,086	433
1924	1,643	1,568	65,837	2,196	10,525	1,065	1,145	2,294	2,005	10,860	928	2,943	358[h]
1925	1,700	1,613	69,024	2,147	11,635	1,077	1,422	1,846[i]	2,091	12,044	949	2,959	358[h]
1926	1,711	1,689	68,127	2,122	11,694	1,070	1,376	1,865[i]	2,068	11,916	956	2,630	347[h]
1927	.....	1,543	69,588	1,977	11,723	1,070	.....	1,860[i]	2,043	12,064	...	2,470	334[j]

B.—PRODUCTION

(Million bushels)

Year	Hungary	Other Balkans[a]	Russia[b]	France	Germany	Belgium and Netherlands[c]	Scandinavia[d]	Spain and Portugal	Czecho-Slovakia	Poland	Austria	Baltic States[e]	Others[f]
Average 1909–13	31.4	38.0	735.5	25.5	368.3	40.7	44.2	29.9	63.5	218.9	23.8	56.0	9.2
1920	20.6	21.7	.....	34.5	194.2	33.3	36.4	33.0	32.9	73.7	10.1	34.6	7.2[g]
1921	23.2	21.3	.....	44.4	267.6	36.7	39.8	32.7	53.7	167.6	13.2	48.5	9.2
1922	25.1	20.1	.....	38.4	206.0	35.8	37.3	31.7	51.1	197.4	13.6	48.6	8.4
1923	31.3	20.7	.....	36.5	263.0	35.8	39.3	33.3	53.3	234.7	15.8	50.5	8.7
1924	22.1	15.9	679.1	40.2	225.6	36.5	21.9	32.3	44.7	143.9	16.2	42.9	8.0
1925	32.5	24.8	815.5	43.7	317.4	38.5	41.0	34.5	58.1	257.4	21.7	59.4	9.3
1926	31.4	26.7	897.3	30.1	252.2	34.1	36.5	27.1	45.9	197.3	18.7	36.3	9.5
1927	22.6	23.7	968.4	36.8	269.0	33.9	29.8	30.9	48.9	223.9	18.2	49.4	8.8

C.—YIELD PER ACRE

(Bushels)

Year	Hungary	Other Balkans[a]	Russia[b]	France	Germany	Belgium and Netherlands[c]	Scandinavia[d]	Spain and Portugal	Czecho-Slovakia	Poland	Austria	Baltic States[e]	Others[f]
Average 1909–13	19.5	14.8	12.0	17.0	29.0	32.4	26.8	13.3	24.4	18.1	21.4	15.1	19.1
1920	13.9	12.5	....	16.1	18.3	32.2	24.1	14.2	14.7	10.2	14.1	13.1	17.8[g]
1921	17.3	12.4	....	19.9	25.4	34.0	26.4	13.9	24.6	18.9	17.4	17.7	21.0[g,h]
1922	15.1	12.7	....	17.5	20.1	34.0	25.7	13.5	23.5	17.6	16.3	16.6	19.7[h]
1923	19.3	13.3	....	16.5	24.4	32.1	26.7	14.2	25.1	20.5	17.2	16.4	20.2
1924	13.5	10.2	10.3	18.3	21.4	34.3	19.2	14.1	22.3	13.2	17.4	14.6	21.1[h]
1925	19.1	15.3	11.8	20.3	27.3	35.7	28.8	16.2[i]	27.8	21.4	22.8	20.1	23.3[h]
1926	18.4	15.8	13.2	14.2	21.6	31.8	26.5	12.6[i]	22.2	16.6	19.6	13.8	23.3[h]
1927	....	15.4	13.9	18.6	22.9	31.7	....	14.3[i]	23.9	18.6	....	20.0	17.8[j]

* Data of U.S. Department of Agriculture. For 1909–13, including U.S. Department of Agriculture estimates for areas within post-war boundaries. In a few cases pre-war averages are for three or four years. Dots (....) indicate that data are not available.

[a] Bulgaria, Jugo-Slavia, and Roumania.

[b] Asiatic and European territory. The pre-war estimate is regarded as too low by Soviet officials.

[c] Including Luxemburg.

[d] Denmark, Norway, and Sweden.

[e] Finland, Latvia, Esthonia, and Lithuania.

[f] Italy, Switzerland, Greece.

[g] Old boundaries for Italy.

[h] Excluding Greece.

[i] Spain only.

[j] Italy only.

TABLE II.—UNITED STATES ACREAGE, PRODUCTION, AND YIELD PER ACRE OF RYE, AND IMPORTS AND EXPORTS OF RYE AND RYE FLOUR, 1890–1928*

Crop year July–June	Acreage (thousand acres)	Production (thousand bushels)	Yield per acre (bushels)	Trade (thousand bushels)		
				Exports	Imports	Net exports
1890-91	2,184	26,414	12.1	358	59	299
1891-92	2,234	32,761	14.7	12,069	0	12,069
1892-93	2,251	29,253	13.0	1,494	0	1,494
1893-94	2,178	28,592	13.1	249	0	249
1894-95	2,164	29,613	13.7	32	0	32
1895-96	2,153	31,139	14.5	1,011	0	1,011
1896-97	2,126	28,913	13.6	8,576	1	8,575
1897-98	2,077	33,433	16.1	15,562	1	15,561
1898-99	2,071	32,888	15.9	10,170	1	10,169
1899-00	2,054	30,334	14.8	2,382	0	2,382
1900-01	2,042	30,791	15.1	2,346	0	2,346
1901-02	2,033	31,103	15.3	2,712	1	2,711
1902-03	2,051	35,255	17.2	5,445	1	5,444
1903-04	2,074	31,990	15.4	784	4	780
1904-05	2,085	31,805	15.3	30	21	9
1905-06	2,141	35,168	16.4	1,388	1	1,387
1906-07	2,186	36,559	16.7	770	1	769
1907-08	2,167	35,455	16.4	2,446	2	2,444
1908-09	2,175	35,768	16.4	1,296	1	1,295
1909-10	2,196	35,406	16.1	242	30	212
1910-11	2,185	34,897	16.0	40	227	(187)[a]
1911-12	2,127	33,119	15.6	31	134	(103)[a]
1912-13	2,117	35,664	16.8	1,855	1	1,854
1913-14	2,557	41,381	16.2	2,272	37	2,235
1914-15	2,541	42,779	16.8	13,027	147	12,880
1915-16	3,129	54,050	17.3	15,250	566	14,684
1916-17	3,213	48,862	15.2	13,703	428	13,275
1917-18	4,317	62,933	14.6	17,186	834	16,352
1918-19	6,391	91,041	14.2	36,467	...	.....
1919-20	6,307	75,483	12.0	41,531	...	.....
1920-21	4,409	60,490	13.7	47,337	...	.....
1921-22	4,528	61,675	13.6	29,944	...	.....
1922-23	6,672	103,362	15.5	51,663	...	.....
1923-24	5,171	63,077	12.2	19,902	...	.....
1924-25	4,150	65,466	15.8	50,242	...	.....
1925-26	3,974	46,456	11.7	12,647	...	.....
1926-27	3,578	40,795	11.4	21,698	...	.....
1927-28	3,670	58,572	16.0	.....	...	.....

* Data from official sources. Import data on a crop-year basis are not available after June 1918, but since 1922, imports of rye and rye flour have been practically negligible; hence net exports would differ little from gross exports in the years 1918–19 and following. Acreage figures are for acreage harvested.

[a] Net import.

TABLE III.—CANADIAN ACREAGE, PRODUCTION, AND YIELD PER ACRE OF RYE, AND NET EXPORTS OF RYE AND RYE FLOUR, 1890–1928*

Crop year	Acreage (thousand acres)	Production (thousand bushels)	Yield per acre (bushels)	Net exports (thousand bushels)
1890-91	122	1,341	11.0	338
1891-92	68	1,135	16.7	219
1892-93	73	1,133	15.5	56
1893-94	71	1,024	14.4	61
1894-95	93	1,447	15.6	60
1895-96	123	1,981	16.1	(5)[a]
1896-97	152	2,283	15.0	212
1897-98	191	3,430	18.0	1,132
1898-99	168	2,737	16.3	317
1899-00	141	2,349	16.7	468
1900-01	177	2,317	13.1	678
1901-02	161	2,610	16.2	411
1902-03	192	3,559	18.5	462
1903-04	184	3,059	16.6	86
1904-05	137	2,128	15.5	6
1905-06	109	1,879	17.1	(35)[a]
1906-07	94	1,651	17.6	(39)[a]
1907-08	74	1,133	15.3	(49)[a]
1908-09	100	1,711	17.0	246
1909-10	91	1,715	18.8	30
1910-11	114	1,537	13.4	52
1911-12	131	2,492	19.0	(37)[a]
1912-13	127	2,428	19.1	(99)[a]
1913-14	119	2,300	19.3	5
1914-15	111	2,017	18.1	179
1915-16	122	2,486	20.4	782
1916-17	148	2,876	19.4	.....
1917-18	212	3,857	18.2	.....
1918-19	555	8,504	15.3	.....
1919-20	753	10,207	13.5	2,523
1920-21	650	11,306	17.5	3,205
1921-22	1,842	21,455	11.8	4,279
1922-23	2,105	32,373	15.5	9,789
1923-24	1,448	23,232	16.0	7,982
1924-25	891	13,751	15.4	6,311
1925-26	643	9,158	14.2	6,200
1926-27	754	12,179	16.2	8,257
1927-28	743	14,951	20.1	.....

* Data from official Canadian sources and International Institute of Agriculture. Acreage, production, and yield figures, 1891–92 and 1892–93, are for Ontario alone; 1893–94 to 1899–1900 and 1901–2 to 1904–5 for Ontario and Manitoba; 1905–6 to 1907–8 for Ontario and Prairie Provinces; 1890–91 and 1900–1901 are census figures for all Canada. Trade figures 1890–91 to 1905–6 are for years ending June 30, thereafter for years ending July 31. Dots (....) indicate that comparable data are not available. Canadian imports of rye and rye flour exceeded 100,000 bushels in only three years, 1912–15, when they ranged from 101,000 to 125,000 bushels.

[a] Net import.

TABLE IV.—ARGENTINE ACREAGE, PRODUCTION, YIELD PER ACRE, AND NET EXPORTS OF RYE, 1909–28*

Calendar year	Acreage (thousand acres)	Production (thousand bushels)	Yield per acre (bushels)	Net exports (thousand bushels)
1909	23	.....	....	3
1910	27	.....	....	36
1911	32	408	12.8	22
1912	38	427	11.2	445
1913	99	1,413	14.3	861
1914	228	3,346	14.7	451
1915	229	1,811	7.9	194
1916	212	2,008	9.5	129
1917	180	858	4.8	(2)[a]
1918	253	843	3.3	2
1919	274	393	1.4	201
1920	205	868	4.2	500
1921	218	821	3.8	726
1922	242	1,692	7.0	1,102
1923	366	3,526	9.6	2,750
1924	404	4,000	9.9	3,185
1925	387	1,457	3.8	213
1926	501	4,733	9.4	2,914
1927	544	3,268	6.0	5,196
1928	895	6,693	7.5	.....

* Data from official sources and International Institute of Agriculture. Dots (....) indicate that data are not available. Acreage figures are for acreage sown for the crop harvested in the year indicated.

[a] Net import.

TABLE V.—RYE RECEIPTS AT PRIMARY MARKETS IN THE UNITED STATES, MONTHLY FROM JULY 1909*

(Thousand bushels)

Crop year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
1909-10	156	557	966	1,032	840	510	524	559	510	355	304	308	6,621
1910-11	166	444	523	493	534	614	435	324	468	255	271	117	4,644
1911-12	193	983	1,359	1,438	1,087	721	647	617	532	336	285	282	8,480
1912-13	159	1,462	2,690	2,935	2,576	1,366	1,125	1,012	961	844	633	623	16,386
1913-14	784	1,741	2,675	2,153	1,435	1,204	960	750	878	672	594	769	14,615
1914-15	529	1,598	3,262	3,210	3,302	2,717	1,479	984	615	446	386	423	18,951
1915-16	255	1,302	3,642	3,725	4,895	2,997	1,594	1,323	1,162	1,110	835	917	23,757
1916-17	656	1,221	3,981	3,906	3,451	2,537	1,425	676	1,124	948	715	494	21,134
1917-18	317	1,613	4,025	4,624	3,106	2,410	1,596	1,890	2,392	1,273	664	473	24,383
1918-19	465	2,158	4,337	5,234	6,210	5,971	5,549	2,390	4,923	5,425	4,246	2,757	49,665
1919-20	3,045	3,580	5,195	4,275	2,412	2,738	4,236	3,180	3,439	2,857	3,696	3,135	41,788
1920-21	3,068	3,118	5,390	4,331	3,647	3,429	1,997	1,341	1,268	1,501	1,315	1,445	31,850
1921-22	2,501	6,066	5,416	2,915	1,885	1,680	1,172	1,523	3,191	1,368	3,514	1,783	33,014
1922-23	1,801	13,934	11,883	7,734	7,704	6,963	7,045	4,647	3,604	3,966	2,141	2,522	73,944
1923-24	1,430	3,812	5,212	3,324	3,442	3,052	6,495	1,829	1,537	929	2,142	3,978	37,182
1924-25	4,890	4,678	14,208	17,608	8,827	3,766	2,072	1,397	784	1,457	4,584	862	65,133
1925-26	384	1,895	6,460	3,343	2,579	2,100	1,499	1,054	1,033	1,248	1,350	1,190	24,135
1926-27	786	1,927	3,873	2,661	2,228	1,237	1,277	2,130	1,462	1,413	3,241	1,360	23,595

* Data for 1909–10 to 1923–24 from *Wheat and Rye Statistics* (U.S. Department of Agriculture Statistical Bulletin 12), January 1926; for 1924–25 to 1926–27 obtained directly from Bureau of Agricultural Economics of U.S. Department of Agriculture. Markets included are Chicago, Milwaukee, Minneapolis, Duluth, St. Louis, Toledo, Kansas City, Peoria, Omaha, and Indianapolis. No record for Indianapolis until 1914–15.

TABLE VI.—RYE SHIPMENTS FROM PRIMARY MARKETS IN THE UNITED STATES, MONTHLY FROM JULY 1909*

(Thousand bushels)

Crop year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
1909-10	174	145	400	568	581	366	325	357	296	287	260	268	4,027
1910-11	174	190	177	233	402	375	383	357	417	185	143	61	3,097
1911-12	61	274	722	619	541	565	437	492	306	388	224	134	4,763
1912-13	93	479	1,428	1,827	1,804	1,004	973	807	1,126	894	557	392	11,384
1913-14	494	835	1,480	1,079	965	958	726	627	823	649	957	606	10,199
1914-15	439	779	2,229	2,552	2,710	2,580	1,593	976	621	357	401	416	15,723
1915-16	180	1,183	1,472	3,531	3,894	2,662	1,621	982	1,210	1,319	897	958	19,909
1916-17	671	613	2,733	2,763	2,962	1,917	1,049	687	938	1,294	1,141	640	17,408
1917-18	222	644	3,494	2,253	2,545	1,179	1,360	1,128	1,370	1,090	478	417	16,180
1918-19	288	818	1,072	4,817	4,872	1,551	760	408	3,232	8,103	7,524	2,728	36,173
1919-20	1,595	1,517	2,347	1,380	3,079	2,301	3,700	2,099	3,069	8,811	7,011	5,448	42,357
1920-21	4,483	2,931	4,288	4,719	2,958	3,149	2,192	1,014	1,052	1,515	1,273	1,426	31,000
1921-22	1,057	4,605	5,526	2,226	1,586	1,783	314	685	838	1,530	7,865	2,976	30,991
1922-23	1,126	12,069	10,038	4,358	7,414	6,769	4,464	2,430	918	967	4,453	3,729	58,735
1923-24	4,049	2,612	3,323	1,148	2,658	1,158	3,239	391	823	960	4,228	5,374	29,963
1924-25	8,129	2,279	16,229	16,365	5,657	7,452	2,819	396	350	1,834	6,571	1,471	69,552
1925-26	3,382	653	2,493	1,308	1,071	331	323	530	741	693	3,338	1,032	15,895
1926-27	2,711	831	1,902	723	1,646	1,454	697	657	516	8,715	7,033	2,026	28,911

* Data for 1909–10 to 1923–24 from *Wheat and Rye Statistics* (U.S. Department of Agriculture Statistical Bulletin 12), January 1926; for 1924–25 to 1926–27 obtained directly from Bureau of Agricultural Economics of U.S. Department of Agriculture. Markets included are Chicago, Milwaukee, Minneapolis, Duluth, St. Louis, Toledo, Kansas City, Peoria, Omaha, and Indianapolis. No record for Indianapolis until 1915–16.

TABLE VII.—VISIBLE RYE SUPPLY IN THE UNITED STATES, MONTHLY FROM JULY 1909*

(Thousand bushels)

Crop year	July 1	Aug. 1	Sept. 1	Oct. 1	Nov. 1	Dec. 1	Jan. 1	Feb. 1	Mar. 1	Apr. 1	May 1	June 1
1909–10	157	93	240	458	642	932	814	784	771	686	630	496
1910–11	378	243	172	353	433	507	491	361	251	114	60	32
1911–12	15	16	316	511	1,165	1,351	1,432	1,099	1,003	828	651	544
1912–13	427	243	441	1,062	1,256	1,888	1,719	1,469	1,202	1,063	684	503
1913–14	449	382	674	1,549	2,032	2,299	2,226	2,085	1,822	1,447	1,165	613
1914–15	369	168	290	1,245	1,897	1,941	1,448	1,445	1,363	779	945	286
1915–16	210	95	536	1,239	1,304	2,686	3,003	3,150	2,377	1,844	1,687	951
1916–17	452	350	418	1,007	2,009	1,962	2,577	2,230	2,014	1,693	1,538	708
1917–18	515	480	727	2,029	3,550	3,818	2,480	1,676	1,225	1,086	1,000	852
1918–19	707	580	1,325	3,829	6,694	11,511	15,687	20,764	17,896	15,193	17,246	11,384
1919–20	8,981	9,866	12,327	15,395	17,248	17,198	17,477	19,195	20,389	18,467	15,560	11,570
1920–21	4,423	2,555	2,210	4,407	2,778	4,320	3,236	2,083	1,978	1,790	1,441	1,131
1921–22	587	1,346	4,371	5,131	6,005	6,846	6,770	7,097	7,227	9,236	8,163	4,358
1922–23	1,635	1,154	4,707	8,180	10,115	10,284	10,193	11,710	14,954	18,268	19,459	16,545
1923–24	15,101	12,726	13,374	15,188	16,960	16,904	19,052	19,874	21,205	21,716	20,374	18,749
1924–25	17,229	14,437	15,279	12,440	17,231	20,543	20,932	23,479	23,381	21,954	12,126	10,226
1925–26	8,706	4,729	4,542	8,726	9,976	11,214	12,702	13,564	13,981	13,443	13,754	11,318
1926–27	10,981	8,666	9,706	11,313	12,824	12,890	12,880	12,929	13,912	14,040	8,212	4,191

* Data for 1909–10 to 1923–24 from *Wheat and Rye Statistics* (U.S. Department of Agriculture Statistical Bulletin 12), January 1926; for 1925–27 from *Daily Market Record*, February 6, 1928. Data are for the Saturday nearest the first of the month, and include grain in regularly authorized warehouses at prominent grain centers of the United States east of the Rocky Mountains, and in transit by canals and lakes. Stocks at Omaha and private elevator stocks at Chicago, St. Louis and Buffalo included after July 1911. Canadian rye in bond included from May 1917 to July 1921.

TABLE VIII.—AVERAGE DAILY VOLUME OF TRADING IN RYE FUTURES IN UNITED STATES MARKETS, MONTHLY FROM JANUARY 1921*

(Million bushels)

Crop year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Year
1920–21	...	...	...	...	...	...	.8	.6	.6	.9	.7	.7	.7[a]
1921–22	.8	.8	.9	.8	.9	.6	.3	1.3	.9	1.1	1.1	1.2	.9
1922–23	1.5	2.2	2.3	2.3	3.4	2.3	1.5	.9	1.0	2.4	1.8	2.3	1.9
1923–24	1.0	1.7	1.8	1.3	1.7	1.1	.6	.6	1.1	2.0	1.0	3.0	1.4
1924–25	4.3	4.0	5.9	6.1	5.1	3.8	4.4	4.1	4.5	3.0	1.9	2.0	4.1
1925–26	1.4	2.0	2.3	1.1	2.1	3.6	1.6	2.2	1.7	2.3	1.5	2.6	2.0
1926–27	3.5	2.0	1.4	1.1	2.4	1.3	2.0	1.7	1.9	2.4	2.6	1.9	2.0

* Data supplied by Grain Futures Administration of U.S. Department of Agriculture. Not compiled prior to January 1921.

[a] Six-month average.

TABLE IX.—INTERNATIONAL TRADE IN RYE (INCLUDING FLOUR) OF PRINCIPAL EUROPEAN COUNTRIES, AVERAGE, 1909–14, AND ANNUALLY, 1920–27*

(Thousand bushels)

Crop year August–July	HUNGARY			OTHER BALKANS[a]			RUSSIA			FRANCE		
	Imports	Exports	Net exports	Imports	Exports	Net exports	Imports	Exports	Net exports	Imports	Exports	Net imports
Average 1909–14.....	120	13,624	13,504	26	4,917	4,891	5,381	32,734	27,353	3,148	19	3,129
1920–21.....	0	0	0	2	5,437	5,435	.....	.....	.....	9,640	26	9,614
1921–22.....	7	34	27	1	1,565	1,564	.....	.....	.....	28	1,295	(1,267)[b]
1922–23.....	2	21	19	0	550	550	.....	8,571[c]	.....	632	570	62
1923–24.....	0	3,804	3,804	0	1,357	1,357	.....	53,143[c]	.....	2,911	906	2,005
1924–25.....	4	5,289[d]	5,285[d]	15	708	693	.....	2,571[c]	.....	1,134	384	750
1925–26.....	1[d]	6,806[d]	6,805[d]	51	505	454	.....	7,094	.....	873	128	745
1926–27[e].....	1	10,040	10,039	0	2,441	2,441	.....	16,251	.....	4,906	1	4,905

	GERMANY			BELGIUM AND NETHERLANDS			SCANDINAVIA			CZECHO-SLOVAKIA		
	Imports	Exports	Net imports	Imports	Exports	Net imports	Imports	Exports	Net imports	Imports	Exports	Net imports
Average 1909–14.....	16,405	42,090	(25,685)[b]	33,883	17,938	15,945	22,496	334	22,162	.....	...	...
1920–21.....	24,256[f]	615[f]	23,641[f]	2,335	1,489	846	6,734	2,444	4,290	3,117	2	3,115
1921–22.....	7,078	947	6,131	1,850	1,398	452	10,203	2,491	7,712	782	113	669
1922–23.....	43,471	495	42,976	4,047	2,427	1,620	14,063	721	13,342	40	364	(324)[b]
1923–24.....	22,315	86	22,223	11,242	2,832	8,410	23,287	615	22,672	5,924	957	4,967
1924–25.....	22,683	5,676	17,007	6,656	3,199	3,457	17,841	513	17,328	5,475	23	5,452
1925–26.....	8,796	14,739	(5,943)[b]	8,257	398	7,859	17,913	489	17,424	6,807	21	6,786
1926–27[e].....	25,311	7,342	17,969	7,462	688	6,774	14,237	1,925	12,312	4,492	54	4,438

	POLAND			AUSTRIA			BALTIC STATES[g]			OTHER[h]		
	Imports	Exports	Net imports	Imports	Exports	Net imports	Imports	Exports	Net imports	Imports	Exports	Net imports
Average 1909–14.....	...	...	...	1,469	2	1,467	.....	...	.....	1,325[i,j]	34[i]	1,291[i]
1920–21.....	...	...	...	1,645	1	1,644	2,626	0	2,626	4,157[j]	3	4,154
1921–22.....	482	386	96	2,139	3	2,136	3,992	98	3,894	54[j]	2	52
1922–23.....	8	1	7	1,708	8	1,700	7,243	133	7,110	926[j]	3	923
1923–24.....	2	2,482	(2,480)[b]	3,888	38	3,850	14,515	14	14,501	190[j]	235	(45)[b]
1924–25.....	2,582	1,721	861	3,138[k]	15	3,123	8,890	164	8,726	64	339	(275)[b]
1925–26.....	59	12,677	(12,618)[b]	3,706[d]	162	3,544	11,364	78	11,286	614[i]	10[i]	604[i]
1926–27[e].....	3,186	3,212	(26)[b]	3,464[i]	167	3,297	9,013	18	8,995	521[i]	2[i]	519[i]

* Data from International Institute of Agriculture. Dots (....) indicate that data are unavailable. Pre-war averages are for territory within pre-war boundaries and in many cases are not comparable with post-war figures. In a few cases pre-war averages are for three-year periods only.

[a] Bulgaria, Jugo-Slavia, and Roumania.
[b] Net export.
[c] Data from Broomhall's *Corn Trade Year Book*, 1927.
[d] Fiscal year ending June 30.
[e] Data incomplete. Figures for rye and rye flour imports of exporting countries, and for rye exports of importing countries are for ten months in most cases.
[f] Eight months figure for rye flour imports and rye and rye flour exports.
[g] Finland, Latvia, Esthonia, Lithuania.
[h] Italy, Greece, Switzerland, Spain.
[i] Excluding Greece.
[j] Excluding Spain.
[k] Eleven months.

TABLE X.—WEIGHTED AVERAGE CASH SALES PRICES OF RYE AND WHEAT IN THE UNITED STATES, ANNUALLY, 1909–27*

(Cents per bushel)

Crop year July–June	No. 2 Rye (Chicago)		Wheat *(60-lb. bushel)*		
	(56-lb. bushel)	*(60-lb. bushel)*	No. 1 Northern Spring (Minneapolis)	No. 2 Hard Winter (Kansas City)	No. 2 Red Winter (Chicago)
1909–10	76	81	109	107	110
1910–11	84	90	105	98	102
1911–12	91	97	107	97	90
1912–13	65	70	87	88	103
1913–14	64	69	88	84	88
Average 1909–14	76	81	99	95	99
1914–15	105	113	120	105	108
1915–16	99	106	109	119	113
1916–17	154	165	176	171	168
1917–18	211	226	220	252	225
1918–19	161	172	225	219	222
1919–20	170	182	272	242	224
1920–21	162	174	207	183	223
Average 1914–21	152	163	190	184	183
1921–22	97	104	143	120	125
1922–23	81	87	120	113	114
1923–24	70	75	117	105	102
1924–25	125	134	156	135	158
1925–26	96	103	161	163	164
1926–27	101	108	146	135	138
Average 1921–27	95	102	141	129	134

* Data from *Agriculture Yearbook, 1926;* 1926–27 figures supplied directly by Bureau of Agricultural Economics of U.S. Department of Agriculture. Figures for rye on 60-lb. bushel basis computed by Food Research Institute.

TABLE XI.—ESTIMATED WEIGHTED AVERAGE RYE AND WHEAT PRICES RECEIVED BY PRODUCERS IN THE UNITED STATES, ANNUALLY, 1909–27*

(Cents per bushel)

Crop year July–June	Rye		Wheat
	(56-lb. bushel)	*(60-lb. bushel)*	*(60-lb. bushel)*
1909–10	74.6	79.9	100.7
1910–11	73.4	78.6	91.7
1911–12	81.0	86.8	88.3
1912–13	68.7	73.6	83.3
1913–14	62.9	67.4	79.3
Average 1909–14	72.1	77.3	88.7
1914–15	83.3	89.3	99.4
1915–16	85.0	91.1	98.2
1916–17	113.0	121.1	144.4
1917–18	176.4	189.0	205.8
1918–19	152.1	163.0	206.3
1919–20	146.9	157.4	218.6
1920–21	148.2	158.8	182.9
Average 1914–21	129.3	138.5	165.1
1921–22	86.9	93.1	104.4
1922–23	68.1	73.0	98.0
1923–24	59.4	63.6	92.4
1924–25	96.3	103.2	127.8
1925–26	83.1	89.0	145.9
1926–27	84.2	90.2	122.8
Average 1921–27	79.7	85.4	115.2

* Data from *Agriculture Yearbook, 1926;* 1926–27 figures supplied directly by Bureau of Agricultural Economics of U.S. Department of Agriculture. Figures for rye on 60-lb. bushel basis computed by Food Research Institute.

TABLE XII.—PRICES OF WHEAT FLOUR AND RYE FLOUR AT CHICAGO, QUARTERLY, 1909–14 AND 1921–27*

(Dollars per barrel)

Period	Wheat flour		Rye flour	
	Straight	First clear	White	Dark
1909–10				
July–Sept.	4.69	4.38	3.82	3.72
Oct.–Dec.	4.67	4.25	3.75	3.64
Jan.–Mar.	4.83	4.13	4.02	3.83
Apr.–June	4.45	3.80	3.86	3.68
July–June	4.66	4.14	3.86	3.72
1910–11				
July–Sept.	4.18	3.66	3.79	3.55
Oct.–Dec.	3.80	3.42	3.87	3.68
Jan.–Mar.	3.74	3.17	4.02	3.81
Apr.–June	3.62	3.22	4.92	4.60
July–June	3.84	3.37	4.15	3.90
1911–12				
July–Sept.	3.62	3.25	4.41	4.21
Oct.–Dec.	3.73	3.40	4.86	4.60
Jan.–Mar.	3.78	3.40	4.66	4.50
Apr.–June	4.20	3.68	4.58	4.45
July–June	3.83	3.43	4.63	4.44
1912–13				
July–Sept.	4.28	3.65	3.70	3.48
Oct.–Dec.	3.94	3.56	3.35	3.18
Jan.–Mar.	3.94	3.41	3.26	3.12
Apr.–June	4.03	3.29	3.19	2.97
July–June	4.05	3.47	3.37	3.12
1913–14				
July–Sept.	3.72	3.39	3.24	3.02
Oct.–Dec.	3.75	3.32	3.17	3.02
Jan.–Mar.	3.75	3.30	2.87	2.72
Apr.–June	3.75	3.29	3.08	2.82
July–June	3.74	3.32	3.09	2.90
1921–22				
July–Sept.	6.24	5.21	7.02	6.45
Oct.–Dec.	5.97	4.33	5.37	5.07
Jan.–Mar.	6.20	4.42	5.58	5.24
Apr.–June	5.95	4.65	5.78	5.42
July–June	6.09	4.66	5.94	5.53
1922–23				
July–Sept.	5.02	4.03	4.59	4.33
Oct.–Dec.	5.33	4.49	4.88	4.50
Jan.–Mar.	5.06	4.56	4.87	4.45
Apr.–June	5.03	4.50	4.35	4.07
July–June	5.11	4.40	4.67	4.34
1923–24				
July–Sept.	4.34	4.02	3.76	3.45
Oct.–Dec.	4.49	4.13	3.88	3.64
Jan.–Mar.	4.67	4.29	4.24	4.02
Apr.–June	4.74	4.24	3.96	3.78
July–June	4.56	4.17	3.96	3.72
1924–25				
July–Sept.	5.52	4.79	5.17	4.94
Oct.–Dec.	6.88	6.14	7.13	6.81
Jan.–Mar.	8.27	7.34	7.93	7.54
Apr.–June	7.55	6.63	6.44	5.75
July–June	7.06	6.23	6.67	6.26
1925–26				
July–Sept.	7.45	6.54	5.51	4.76
Oct.–Dec.	7.51	6.49	5.03	4.31
Jan.–Mar.	7.97	6.66	5.51	4.43
Apr.–June	7.25	6.35	5.21	3.94
July–June	7.55	6.51	5.32	4.36
1926–27				
July–Sept.	6.20	5.72	5.98	4.36
Oct.–Dec.	6.18	5.73	5.80	4.37
Jan.–Mar.	5.91	5.48	5.96	4.52
Apr.–June	5.82	5.43	6.03	4.43
July–June	6.03	5.59	5.94	4.42

* Averages computed from weekly quotations compiled from the *Northwestern Miller*. In each case the cheapest wheat flour and the dearest rye flour quotations available for the specified grades were selected.

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VOL. IV, NO. 6 MAY 1928

SURVEY OF THE WHEAT SITUATION

DECEMBER 1927 TO MARCH 1928

DURING the first half of the period under review, world wheat markets were quiet and prices fluctuated within narrow limits. Visible supplies, especially in Canada, were high; changes in the supply situation, aside from increasing tightness in the feed grain situation, were of little significance; speculation was not active; buyers of wheat exerted little pressure to obtain supplies. International trade followed a normal course throughout the period. Exports from Argentina and the Pacific coast of North America were exceptionally large, while very little wheat as wheat was exported from Atlantic and gulf ports of the United States. During February and March unfavorable reports of the United States soft red winter-wheat crop of 1928 led to a sharp increase in prices and a revival of speculative interest, most noteworthy in Chicago.

In the closing four months of the year international trade promises to be of large volume, though not so large as in 1926–27. A record export movement may occur from Canada, where stocks on March 31 where the largest in history; the United States will probably export little, especially of representative wheats. Total net exports for the crop year still seem likely to approximate 825 bushels. Carryovers in the more important positions in their aggregate bid fair to be as large as or larger than those of 1926–27. The outlook for 1928 crops is of course not clear, but on the basis of available data on acreage, condition, and abandonment of winter-wheat crops, and general statistical probabilities for spring-wheat crops, the Northern Hemisphere (ex-Russia) will probably harvest less wheat this year than last. The changing outlook for new crops bids fair to dominate price movements. In the United States milling activity seems likely to run above the usual seasonal level.

STANFORD UNIVERSITY, CALIFORNIA

May 1928

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STANFORD UNIVERSITY, CALIFORNIA

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SURVEY OF THE WHEAT SITUATION

DECEMBER 1927 TO MARCH 1928

The features of the world wheat situation of outstanding interest during the second third of the international crop year were the enormous supplies of wheat accumulated in commercial visibles, especially in Canada, and the upward trend of prices after mid-February, as the effects of extensive deterioration during the winter became increasingly apparent in the soft red winter-wheat region of the United States. There were no extensive revisions of wheat-crop estimates during the period. The first official estimate of Russian production, appearing in February, was 60 million bushels lower than that of 1926, but exerted little influence on world markets. On the whole, the international statistical position appears to have changed but slightly since December, though high prices of rye and feed grains have probably encouraged the use of wheat both for food and feed, and German and Polish rye production estimates were somewhat lowered.

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According to official estimates now standing, the world wheat crop of 1927 (exclusive of China and Asia Minor) appears the largest of post-war years, about 70 million bushels larger than the crop of 1926; but, trends considered, it cannot be regarded as much above normal. In distribution between importing and exporting countries the crop of 1927 was not unusual. Among the exporting countries, Canada and Argentina harvested the second largest crops in history; moreover, the Canadian official estimate may be somewhat too low. The Australian crop, while not a failure, was the smallest in post-war years. The size and distribution of crops throughout the world suggested a fairly easy international statistical position for the crop year.

Until the crop outlook began to exert an influence in February, world markets were quiet and prices fluctuated within a narrow range. European buyers, faced with an easy international position and large visible supplies, pursued a policy of leisurely but not niggardly purchasing. As compared with 1926–27, prices of native wheats were distinctly lower in several countries of western Europe; import wheats in Europe were perceptibly lower, but not so much so as native wheats; and wheats in exporting countries were almost as high as was true a year ago. This situation was largely due to the abnormally high ocean freight rates prevailing during the first half of 1926–27.

With ocean freight rates again at a normal or low level, international trade, though of large volume, was not so heavy as in 1926–27, when the flow of wheat to export was restricted in the first third of the year and arrears were partially caught up in the second third. This year an exceptionally heavy movement of wheat and flour occurred from Argentina and the Pacific coast of North America, while very little wheat moved from gulf and Atlantic ports of the United States after November.

In the light of accumulated information, we regard our December estimate of probable net exports for the crop year, 825 million bushels, as reasonably in prospect of fulfilment, though slightly too low. On the basis of seasonal movements of exports in past years and official estimates of stocks, Canadian net exports in April–July may prove the largest in history, unless the carryover is built up to an extreme height; but United States exports (April–June) may prove small. The volume of trade from all sources promises to be large, but is likely to fall below the record figure established last year. Carryovers promise to be large for the second successive year, especially in Canada.

The winter proved unfavorable for fall-sown wheat in the United States east of the

Mississippi and in some European countries, especially France; in these areas abandonment has apparently been exceptionally heavy. On the other hand, the areas sown throughout the Northern Hemisphere in the autumn of 1927 were larger than in the autumn of 1926, the greatest increases being reported in Russia and the United States. The outlook for the crops of 1928 is of course not clear. Against heavy abandonment and low condition in the American soft red winter-wheat belt, not altogether satisfactory supplies of moisture in parts of the hard red winter-wheat belt, and spring condition apparently below average in parts of Europe, are to be set the large acreage sown to winter wheat and the fair supplies of subsoil moisture elsewhere, including most of the North American spring-wheat belt. Principally on account of a prospective reduction of the United States winter-wheat crop, and the general probability that the American and Canadian spring-wheat crops are unlikely to attain the exceptionally high figures of 1927, the Northern Hemisphere crop of 1928 seems likely to fall below that of 1927. But even so much cannot be said with assurance while weather during the growing season remains unpredictable. Changing prospects for new crops may be expected to dominate price movements.

I. SUPPLY AND DEMAND FOR THE CROP YEAR

Changes in Supplies

On the side of supply, the international statistical position has been little affected either by the appearance of the first official estimates of wheat production for a few countries, or by revisions of official estimates for several others. Earlier estimates of the Canadian and Australian crops were revised downward by 4 and 6 million bushels respectively; estimates for Tunis and Germany were revised upward by 3 and 7 million bushels. The final estimate of the Argentine crop, 239.2 million bushels, was only about half a million bushels below the December estimate.

Other revisions were not especially noteworthy for their bearing on trade and prices. The new estimates of production in Denmark, Chile, and Uruguay indicated crops well above average, with a bumper post-war crop of 33 million bushels in Chile; but the South African crop is small. The first official Russian estimate, appearing in February, placed the crop as 750 million bushels as compared with 810 million in 1926 and 713 million in 1925. On the whole the estimate merely served to confirm the impression of observers that smaller exports might be expected this year than last. The reduction from 1926 was not regarded as indicating a shortage of wheat for domestic consumption, not only because stocks in peasant hands were thought to be large, but also because the rye crop was placed at 968 million bushels, as against 897 million in 1926 and 816 million in 1925.

Table 1 summarizes the latest available official data on wheat production in 1927, with comparisons for earlier years. As seemed likely in December, the world wheat crop exclusive of Russia, China, and Asia Minor approximates the bumper post-war crop of 1923; and it exceeds the crop of 1926 by about 130 million bushels.[1] With Russia included in the comparison, the crop of 1927 exceeds that of 1926 by about 70 million bushels, and probably exceeds the crop of 1923 by a still larger amount.[2] Yet, in view of the upward trend of wheat production and consumption since the war, it can hardly be regarded as much above normal. Recent revisions have scarcely affected the distribution of crops between importing and exporting countries. The Danube countries, Russia, and the Southern Hemisphere have smaller crops this year than last, while European importing countries and North America have larger. But on the whole the distribution is normal, as in 1926 and 1923.

[1] These comparisons are based on official estimates. There is reason to believe that official estimates are too low for the United States crops of 1925 and 1926, the Canadian crops of 1924–27, and the French crop of 1926. Rough allowances for apparent underestimates suggest that the wheat crop of the world (excluding Russia, China, and Asia Minor) in 1927 was not so much as 130 million bushels larger than the crop of 1926.

[2] Russian official estimates are comparable only for the past three years. In 1923, however, the Russian crop seems not to have exceeded 500 million bushels.

The most conspicuous features of production are the large crops of Canada and Argentina — for each country the second largest of post-war years; and the small crop of Australia, which was considerably exceeded in each year except 1922, when the crop was less than half a million bushels larger.

In recent months no indications have appeared to suggest that the world's wheat crop differs noticeably in quality from what was earlier apparent or expected. The Australian crop is reported to be of good quality. Test weight per bushel of the Argentine crop is high, and many sales have been made under a guaranty of 64 pounds

TABLE 1.—WHEAT PRODUCTION IN PRINCIPAL PRODUCING AREAS, PRE-WAR AND POST-WAR*

(Million bushels)

Year	United States	Canada	Soviet Russia	Lower Danube[a]	Other Europe	North Africa	India	Japan, Chosen	Northern Hemisphere ex-Russia	Argentina	Australia	Southern Hemisphere	World ex-Russia
1920	833	263	...	172	775	71	378	41	2,550	156	146	350	2,900
1921	815	301	...	212	1,004	98	250	40	2,727	191	129	376	3,103
1922	868	400	...	224	815	72	367	40	2,801	196	109	354	3,155
1923	797	474	...	260	989	106	372	35	3,051	248	125	427	3,478
1924	864	262	...	204	847	85	361	37	2,673	191	165	407	3,080
1925	676	395	713	296	1,096	105	331	40	2,951	191	115	359[b]	3,310[b]
1926	831	407	810	298	909	90	325	40	2,912	221	161	436[b]	3,348[b]
1927	872	440	750	275	988[c]	105	334	38	3,066[c]	239	109	415[b]	3,481[bc]
Average 1909–13	690	197	759[d]	330	1,018	92	352	32	2,724	147	90	280	3,004
1922–26	808	388	...	257	931	92	351	38	2,877	209	135	397[b]	3,274[b]

* Summarized from most recent official data for individual countries (see Appendix Table I), as reported by the U.S. Department of Agriculture, supplemented in a few cases by our own rough estimates. Totals exclude China, Asia Minor, Brazil, and a number of small producers. All estimates are for territory within post-war boundaries.

[a] Hungary, Bulgaria, Roumania, Jugo-Slavia.
[b] Includes our estimate for Peru.
[c] Includes our estimate for Ireland.
[d] Regarded as too low by Soviet officials, whose estimate is 908 million bushels.

It is as yet impossible to judge with certainty of the accuracy of official estimates now standing, yet certain possibilities deserve mention. Observers agree that the Australian and Argentine official estimates are certainly not too high; indeed, some regard the Argentine as too low. Conclusive checks on the Argentine estimates remain impossible in the absence of direct estimates of stocks; the exceptionally heavy exportation of January–March may reflect merely the fulfilment of sales made in October–December rather than a conviction among Argentine traders that wheat is more plentiful than the official estimate suggests. The Canadian crop is perhaps larger than 440 million bushels, if data on stocks and exports are trustworthy.[1] No substantial reasons appear at present for questioning the accuracy of crop estimates for the United States or the major producers of Europe, though the French official crop estimate, of which a revision will not appear until May or June, is lower than the private estimates.[2]

per measured bushel. The American crop has proved to be somewhat above average in weight per bushel and the percentage grading No. 2 or better has not been low;[3] but the prevailing high premiums bear evidence of low protein content.[4] The proportion of damp wheat unfit for milling is known to be large in northwestern Europe, especially England, Belgium, Holland, Germany, and France; but whether or not the proportion is larger than seemed likely earlier in the season is not clear. Canadian wheat has continued to grade low; of all wheat inspected in the western division during September–March, less than 10 per cent

[1] See below, pp. 250–51.

[2] See WHEAT STUDIES, IV, 108n.

[3] According to official estimates published in March, the percentages of the winter- and spring-wheat crops grading Nos. 1 and 2 have been as follows for the past six years:

Crops of	Winter wheat	Spring wheat	Crops of	Winter wheat	Spring wheat
1922	51.3	78.5	1925	73.4	65.5
1923	63.6	45.2	1926	83.2	64.8
1924	73.1	84.4	1927	73.1	71.0

[4] See below, pp. 254–55.

has graded No. 1 and No. 2, while the quantities grading No. 3, Nos. 4–6, and "no grade" have run exceptionally high. The figures are shown in Table 2. No. 3 Northern has proved more difficult than usual to mill because the bran does not separate easily from the endosperm; and, with the wide spread between the prices of No. 3 and No. 4 Northern, some millers have found it possible to produce comparable flours more cheaply from the lower grade. The official April estimate of percentage of the crop not merchantable was 6 per cent this year, as against 5 per cent in 1926–27, and 3 per cent in 1925–26.

With respect to rye and the feed grains, developments during December–March suggest a somewhat tighter situation in Europe and North America than was envisaged earlier in the year. Data on European grain and potato crops are summarized in Table 3. Official estimates of German and Polish rye production were reduced by nearly 30 million bushels in January, and quality in several countries of western Europe now appears poorer than had been supposed.

TABLE 2.—PERCENTAGES OF VARIOUS GRADES OF CANADIAN HARD RED SPRING WHEAT TO TOTAL WHEAT INSPECTED IN THE WESTERN DIVISION, SEPTEMBER–MARCH 1923–28*

	1923–24	1924–25	1925–26	1926–27	1927–28
No. 1 Northern...	38.3	19.6	23.2	10.3	1.0
No. 2 Northern...	25.2	18.3	27.0	18.5	8.1
No. 3 Northern...	22.3	18.5	13.5	8.1	21.9
Nos. 4, 5, 6 Northern.....	9.3	28.4	4.2	5.5	18.3
Feed, etc.[a].....	3.1	1.8	1.3	2.6	1.2
No grade[b].....	1.0	11.1	28.2	48.2	44.9
Total above.....	99.2	97.7	97.4	93.2	95.4
Total inspections.	100.0	100.0	100.0	100.0	100.0

* Data from *Canadian Grain Statistics.*

[a] Includes also rejected, condemned, and no established grade.

[b] Wheat containing a higher proportion of moisture than wheat of numbered grades. Aside from higher moisture content, it may be of as good quality as the numbered grades, and is always better than feed, rejected, or condemned wheat.

Estimates of potato production were raised by about 95 million bushels; but again the quality is reported to be poor. European crops of rye, potatoes, barley, and oats still appear well above average, though the corn crop is small. By comparison with 1926, Europe has larger crops of wheat, rye, and potatoes, but smaller crops of corn, barley, and oats. Poor quality of rye, marked shortage of corn, a smaller crop of oats, and

TABLE 3.—EUROPEAN (EX-RUSSIAN) GRAIN AND POTATO CROPS, 1920–27*

(Million bushels)

Year	Wheat	Rye	Potatoes	Corn	Barley	Oats
1920.....	947	532	3,351	520	551	1,478
1921.....	1,216	758	3,078	393	566	1,509
1922.....	1,039	713	4,803	426	602	1,542
1923.....	1,249	824	3,864	475	668	1,814
1924.....	1,051	651	4,216	591	577	1,622
1925.....	1,392	938	4,756	627	694	1,794
1926.....	1,207	746	3,837	663	691	1,913
1927.....	1,263	796	4,614	485	680	1,848
Average 1909–13...	1,348	976	4,163	528	701	1,931
1922–26...	1,188	774	4,295	556	646	1,737

* Summarized from most recent official data for individual countries, as reported by the U.S. Department of Agriculture. Excludes a few minor European producers. Pre-war averages are estimates for territory within present boundaries, and include 2-year or 4-year averages for a few countries. Figures for 1927 partially estimated.

a larger live-stock population have resulted in higher prices both of rye and of feed grains this year than last,[1] while wheat prices have been lower. This situation may well have tended to encourage the use of wheat both for food and feed, and hence to support wheat prices.[2] In the United States and Canada also rye and the feed grains have sold at higher prices relative to wheat this year than last. The extent to which substitution is practiced in Europe is not well understood, and the effect of a shortage of rye and feed grains upon the demand for wheat is perhaps more easy to overestimate than to underestimate.

PROBABLE NET IMPORTS

In the absence of statistics of net imports later than February, and because the tak-

[1] Millfeed, both in Europe and the United States, has also commanded high prices. The situation has apparently been fortunate for the Canadian Pool. Sales of the immense quantities of low-grade Canadian wheat have been facilitated by the fact that English millers could employ it profitably in spite of low yield of flour, since high yield and prices of offals proved remunerative.

[2] See U. S. Department of Agriculture, *Foreign News on Wheat,* February 23, 1928; *Foreign Crops and Markets,* March 19, 1928, XVI, 360–69.

ings of several important European countries in the later months of the crop year depend upon prospects for an early or late harvest of domestic wheat, we consider a revision of our December estimates of European net imports[1] premature at this time. At best, estimates of net imports are significant not in their relation to net exports (since totals cannot be expected to balance), but because they provide a rough guide to the extent of demand in various countries.

So far as can be judged by available statistics of net imports,[2] it seems probable that complete data for the year will show our December estimates too high for the British Isles and Italy, and slightly too low for the other major importing countries of western Europe. In the first half of the year at least, it has become increasingly apparent that poor quality of wheat and the feed grain situation in central and western Europe have tended to increase human and/or animal consumption of wheat; and less obvious influences, not yet clear, have probably had their effect. Nevertheless, again for reasons not yet clear, demand for wheat has proved weaker than was earlier expected in some countries; and on the whole the quantitative demand for wheat in Europe has shown only imperceptible change. Broomhall has made no changes since November 29 in his detailed estimates of shipments to European countries, though on January 10 he increased his estimate of total shipments to Europe by 12 million bushels, and decreased his estimate of shipments to ex-Europe by a similar amount. Between November 21 and April 18, the United States Department of Agriculture estimates of net imports of European countries (July–June) were increased but slightly, from a range of 600–685 million to a range of 608–683 million.

Probable Net Exports

In the light of accumulated data on crops, trade, and stocks, revisions of our December estimates of probable net exports for the crop year may be undertaken. These are shown in Table 4, in comparison with estimates of Broomhall and of the United States Department of Agriculture. Comparisons are somewhat misleading in that Broomhall's estimates are apparently for overseas shipments, which are always lower than net exports, while the Department of Agriculture estimates apply to a crop year July–June.

Table 4.—Forecasts of Probable Net Exports by Exporting Countries in 1927–28*

(Million bushels)

Exporting area	Broomhall	U.S.D.A.		F.R.I.	
	Dec. 20	Nov. 21	Apr. 18	Dec. 20	Apr. 20
United States..	216	220-245	210-230	225	205
Canada.....	272	300-330	310-340	317	343
Argentina.....	160	120-170	140-170	151	156
Australia.....	60	55- 80	55- 80	74	65
Russia.....	8	5- 30	7- 15	20	10
Danube basin[a].	36	22- 41	22- 44	30	35
India.....	12	5- 10	8- 10	8	10
Others.....	8[b]	3- 16[c]	3- 16[c]	...	5[d]
Total.....	772	730-922	755-905	825	829

* For crop year August–July, except U.S.D.A. estimates and F.R.I. estimates of United States exports, which are for the year July-June. Broomhall's figures are for probable shipments. Dots (....) indicate items for which no estimate was made.

[a] Roumania, Bulgaria, Hungary, and Jugo-Slavia.
[b] North Africa and Chile.
[c] Algeria and Chile.
[d] North Africa, Chile, and Uruguay.

Our December estimates now appear too high for the United States, Russia, and Australia; and too low for Canada, Argentina, the Danube countries, and India. It further seems probable that net exports from other countries—Chile, Uruguay, and North Africa—will reach at least 5 million bushels. Increases and decreases in their aggregates are of about the same size; and total net exports of 829 million bushels seem likely to exceed our December estimate by only 4 million. The volume of trade for the crop year 1927–28 still bids fair to be exceeded only by that of 1926–27, some 848 million bushels; but there is now little reason to suppose that last year's figure will be equaled or surpassed. Precise forecasts are of course not yet feasible; our present revisions for each country and the total must be regarded as approximations to the middle of a range, though the range is narrower than was true in December.

[1] See Wheat Studies, IV, 124 f.
[2] See Appendix Table II, and below, pp. 244–45.

Russian net exports for the crop year now promise to fall below our December estimate of 20 million bushels. During August–March Broomhall recorded shipments of 4.8 million, with no movement in March. Shipments through the Bosporus, August–February, were 5.1 million; official net exports, August–November, were 5.2 million.[1] In spite of larger collections of grain during January–March than were obtained earlier in the year, it seems unlikely that exports in April–July will prove heavy enough to bring total net exports for the year above 10 million bushels; and a smaller figure is more probable than a larger one.

Our December estimate of net exports from the Danube countries — Hungary, Jugo-Slavia, Roumania, and Bulgaria—was 30 million bushels; but a slightly larger total now seems probable. Hungarian net exports in August–February, Roumanian in August–January, and Jugo-Slavian in August–December, were 23.2 million bushels. Confirmatory data are lacking, but a few million bushels must have been exported from Bulgaria in view of the record of recent years and the fact that the crop of 1927 was the largest since the war. Some exportation usually occurs from Hungary and Roumania in March–July, and no reason appears for supposing that there will be none this year, though Roumanian and Jugo-Slavian exports will presumably prove small. It has recently been reported that a greater relaxation of import prohibition in Poland than has prevailed in earlier months must occur in the spring;[2] under existing commercial treaties, this would tend to widen the market for Hungarian wheat. In view of these developments, we raise our estimate of net exports from Danube countries in 1927–28 to 35 million bushels.

The prospects for Indian net exports are not clear. Broomhall has recorded shipments from India in August–March of 3.6 million bushels, and shipments to India of 1.5 million. Exports, gross for all months but October, were officially reported at 4.5 million bushels in August–January.[3] If the crop now being harvested proves as large as present indications suggest, exports of more than 5 million bushels may reasonably be expected in May–July, especially in view of considerable activity in chartering reported in Karachi. We are tentatively disposed to raise our December estimate from 8 to 10 million bushels.

In view of official estimates of large crops in Chile and Uruguay, it now seems possible that about 5 million bushels—rather more than less—may be exported net during the year from these countries and North Africa. Crop statistics available in December did not justify an estimate at that time.

Considerable variations in the seasonal movement of Australian net exports in recent years of small crops like that of 1927, and the absence of direct estimates of carryovers, combine to render difficult any reliable estimate of probable net exports during April–July this year. In four of the past six years when crops have ranged from 110 to 129 million bushels, net exports during April–July have averaged 25 million. The crop estimate for 1927 has been revised downward from 115 to 109 million bushels; consequently there is a reduction in the quantity of wheat available for export. No good reason appears for supposing that stocks on August 1 will be abnormally large or small; favorable seeding conditions, low freight rates, and the recent advance in import prices, favor exportation rather than accumulation of stocks. We therefore anticipate a larger export in April–July 1928 than occurred in the last third of 1922–23 or 1925–26[4] (18 and 22.7 million bushels respectively), and tentatively place the figure at 25 million. On this calculation, since exports during August–March were about 40 million bushels, exports for the crop year would reach 65 million bushels, or 9 million below our December estimate.

For Argentina also variations in the April–July export movement have been rather large in recent years, and no direct estimates of stocks are made. Net exports of about 113 million bushels were made in August–March from a crop and carryover of about 300 million. Our estimates for seed,

[1] See *Foreign Crops and Markets*, March 26, 1928, XVI, 413.

[2] *Corn Trade News*, March 27, 1928.

[3] A net import of slightly over half a million bushels was reported in February.

[4] These are the post-war years with crops most nearly comparable in size to that of 1927. See Appendix Table I. The April–July exports in 1923 and 1926 were, moreover, abnormally small; in 1923 because the two preceding crops had been small, in 1926 because the export movement in January and February had been abnormally heavy, size of crop considered.

food, and feed, which seem reasonably accurate, total 85 million bushels; hence it appears probable that about 102 million bushels were available on April 1 for export during April–July and carryover on August 1. So far as can be ascertained, year-end stocks in Argentina vary but little, and approximate 60 million bushels. If stocks reach this figure, it seems probable that only about 42 million bushels will be exported in April–July. The quantity is small by comparison with net exports for these months of 1924 and 1927, which were 76 and 66 million bushels respectively; but it appears not unreasonable in view of the extraordinarily heavy exports in January–March. The principal uncertainties lie in possible errors in estimates of crop and carryovers, which cannot at present be anticipated; but understatements seem more probable than overstatements, and exports will presumably exceed rather than fall below our figures.

In the United States the situation is somewhat more clear, partly because data are available for 9 months of a July–June crop year. In the past six years April–June net exports have varied between 21 and 40 million bushels. The years of smallest exports were 1924, when prices were very low in March–April, and 1926, when little representative wheat was available for export throughout the year. With prices advancing at least to April 24 more rapidly in the United States than in import markets on account of unfavorable crop prospects, an active milling demand induced by the necessity of a high seasonal output, and little or no red winter or hard spring wheat available for export, April–June exports equal to those of 1927 (40 million bushels) seem improbable. On the other hand, fair quantities of Pacific and durum wheats and flour are apparently available; stocks (not held by city mills) on March 1 were larger by 60 million bushels than in 1926; and prices are presumably more conducive to movement from farms than was the case in 1924. In these two years April–June net exports were 27 and 21 million bushels respectively; exports as small as these seem improbable. During January–March, net exports of wheat as wheat were only 6.8 million bushels. In our judgment April–June net exports this year will not exceed 35 million bushels, and may prove smaller. This figure implies net exports for the year of 205 million bushels, 20 million below our December estimate. Unless the harvest is early in the United States or late in Europe, net exports for the year August–July will probably differ little from those of July–June.

Net exports from Canada for 1927–28 promise to exceed our earlier estimate of 317 million bushels by 26 million bushels. As of March 31, stocks in all positions in Canada were estimated as 220 million bushels.[1] By subtracting from total March 31 stocks the quantity of wheat required for seed, and one-third of the annual requirement for food (items which may be estimated within a small margin of error), one can reach a fairly accurate estimate of the amount of wheat available for export during April–July and carryover on July 31, though, on the basis of past experience, the amount so calculated is likely to prove too low. The calculation is as follows for the past six years, in million bushels:[2]

Crop year August–July	Stocks March 31	Seed and food	Available for export and carryover	Actual export and carryover	Discrepancy[a]
1922–23 ...	140	54	86	95	− 9
1923–24 ...	202	53	149	144	+ 5
1924–25 ...	121	53	68	80	−12
1925–26 ...	161	54	107	119	−12
1926–27 ...	176	53	123	131	−10
1927–28 ...	220	56	164	...	...

[a] Amount by which estimated supplies available on March 31 for export and carryover proved too high (+) or too low (−).

On this calculation, about 164 million bushels were available for export and carryover, probably somewhat more.

[1] See Appendix Table VIII.

[2] Data on March 31 stocks shown in Appendix Table VIII; on seed, food, and carryovers in Appendix Table XII and Wheat Studies, IV, 61. The stocks reported on March 31 apparently ought to include wheat which is used for other purposes than seed, human food, export, and carryover in April–July—that is, wheat lost in cleaning and merchantable wheat fed on farms, and perhaps also unmerchantable wheat. But these items are difficult to estimate; and any allowance for such disposition increases considerably the amount by which supplies available for export and carryover calculated on March 31 stocks have proved too low (except in 1923–24).

Precisely how much of this quantity will be exported, how much carried over, of course cannot be said. Presumably the Pool has not at present an incentive to increase the carryover above that of August 1, 1927, which reached the record figure of 48 million bushels and was accumulated largely because crop prospects were unfavorable. Nevertheless some increase is probable, partly because carryovers in Canada would tend to increase (size of crops remaining constant) with growth of storage space and population; partly because the Pool policy of equalizing the flow of wheat throughout the year implies larger carryovers on July 31. Furthermore, lake navigation is opening later than usual. The carryover at the end of 1927–28 may perhaps approximate 55 million bushels; if so, exports of over 115 million bushels may be made in April–July—the largest quantity ever exported from Canada in these months. This calculation implies that the official crop estimate is too low.[1]

As appears from Table 4 (p. 239), the principal differences between our revised estimates and the latest available data of Broomhall and the United States Department of Agriculture are our lower figure for the United States and higher figure for Canada. Our estimate of probable net exports exceeds Broomhall's standing estimate of probable shipments by nearly 50 million bushels—a large discrepancy, even though shipments as recorded by Broomhall are never so large as officially reported net exports. In our judgment Broomhall's figure for shipments will prove too low, but not, of course, by so large an amount as the quantity indicated by the difference between standing estimates of shipments and of net exports.

II. INTERNATIONAL TRADE, DECEMBER–MARCH

Developments in international trade during the past four months have been such as to strengthen our belief that trade for the crop year 1927–28 will prove less heavy than in 1926–27. Under a more normal level of ocean freight rates than prevailed last year, the August–November movement proved larger than in 1926–27, the December–March movement smaller. A record proportion of the total trade for the season was shipped from North America and Argentina. Australian shipments were relatively small because of the small crop, and Russian exports were almost negligible. Noteworthy features of the period were the heavy exportation from the Pacific coast of North America, and the practical cessation of exports of wheat as wheat from Atlantic and gulf ports of the United States during the months of January–March. Among the importing countries, Italy and France imported much less wheat this year than last, while the countries of central Europe, and Brazil, and the Orient imported considerably more.

Volume and Course of Trade

The volume of international trade in wheat and flour, as measured by Broomhall's shipments data summarized in Table 5, reached 273 million bushels in December–March. Higher figures were recorded only in 1926–27, when the record total of 299 million bushels was shipped; but in 1923–24 and 1924–25 shipments were of practically the same size. This year's shipments are low by contrast with those of 1926–27 principally because exceptionally heavy shipments were necessitated in December–March last year in order to make up defi-

Table 5.—International Wheat and Flour Shipments (Broomhall) by Destinations*

(Million bushels)

Year	December–March (17 weeks)			August–March (34 weeks)		
	Total	To Europe	To ex-Europe	Total	To Europe	To ex-Europe
1920–21..	181.4	164.9	16.5	355.6	326.9	28.7
1921–22..	223.6	180.8	42.8	441.0	365.4	75.6
1922–23..	225.9	196.0	29.9	444.7	385.2	59.5
1923–24..	270.1	203.0	67.1	492.0	380.5	111.5
1924–25..	272.0	242.1	29.9	527.0	470.5	56.5
1925–26..	234.7	175.6	59.1	442.2	342.3	99.9
1926–27..	299.1	252.8	46.3	531.9	449.1	82.8
1927–28..	272.7	222.9	49.8	524.6	443.8	80.8
Average						
1909–14..	189.9	161.9	28.0	406.5	353.0	53.5
1922–27..	260.3	213.9	46.4	487.6	405.5	82.1

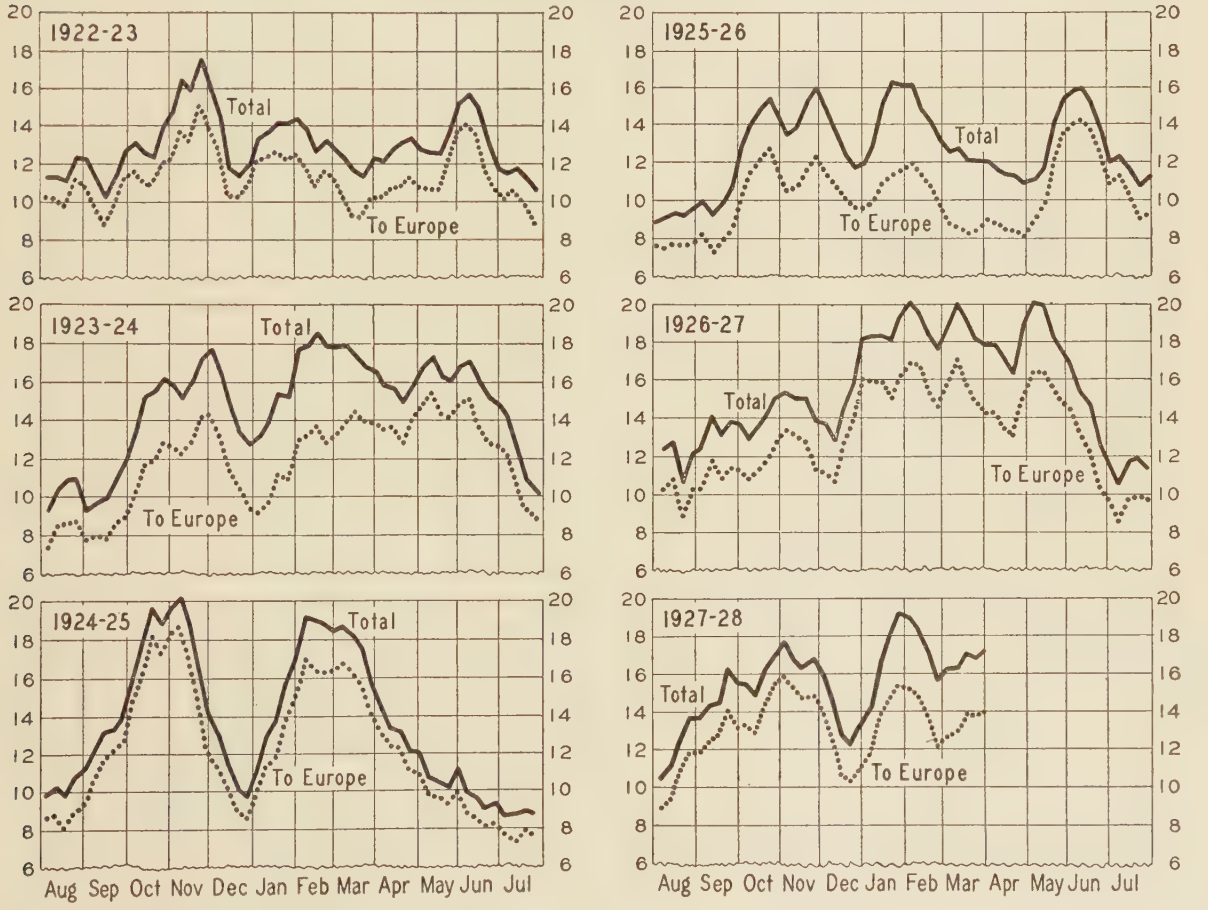
* Data from Broomhall's *Corn Trade News*.

[1] See below, pp. 250–51.

cient shipments in August–November, when high ocean freight rates curtailed the export movement. Shipments during August–March have totaled 525 million bushels, only 7.2 million less than in 1926–27 and larger than in any other post-war year except 1924–25. Thus far in the crop year 1927–28 international trade has been of the volume that might have been expected in view of the size and distribution of wheat crops. Broomhall's shipments data understate net exports, especially from the Danube countries. But the understatement is presumably less important this year than last, since less wheat appears to have moved from Russia by rail and river.

CHART 1.—INTERNATIONAL SHIPMENTS OF WHEAT AND FLOUR, WEEKLY FROM AUGUST 1922*

(Million bushels: 3-week moving average)



* Broomhall's data, from the *Corn Trade News*.

The course of trade (shown in Chart 1 with comparisons for the past five years) has shown no striking features. The normal seasonal decline occurred in December with the closing of navigation on the Great Lakes. The subsequent recovery in January, as the new Argentine and Australian crops began to be shipped, was timed about as usual. It occurred later than last year, when as a result of a shortage of wheat in near positions in Europe, coupled with sharply declining freight rates, importers purchased abnormally large quantities of North American wheat; and hence North American shipments in late December and early January were large. An early harvest of Australian and Argentine crops also contributed to the earlier mid-winter increase of trade in 1926–27.

Shipments showed their normal decline in February, somewhat more marked than usual. In late February and March the move-

ment had become much smaller than that of last year. This was to be expected from the manner in which abnormally high ocean freight rates in September–November 1926 restricted exports in the first half of the crop year 1926–27 and gave rise to exceptionally heavy exports in the second half. This year ocean freight rates have remained at or below normal levels; exports were not restricted in the first half of the year, and were naturally smaller in the first part of the second half. Observers who forecast total shipments for the current crop year chiefly by reference to comparisons of shipments only in the present and preceding year have been misled by the abnormal movement of 1926–27. Not until the week ending March 3, 1928, did Broomhall's cumulative total of shipments for 1927–28 fall below that of 1926–27, the year in which trade was of record volume.

Distribution of Imports

During December–March, as appears from Table 5 (p. 242), Broomhall recorded shipments of 223 million bushels of wheat and flour as wheat to European destinations, the largest quantity in any post-war year except 1924–25 and 1926–27. August–March shipments were also larger in these two years, as might be expected in view of smaller wheat crops in Europe. In further detail, the distribution by destinations of December–March and August–March shipments to Europe in 1926–27 and 1927–28 was as follows, in million bushels:

Destination	December–March (17 weeks)		August–March (34 weeks)	
	1926–27	1927–28	1926–27	1927–28
Orders	65.5	60.6	90.4	91.3
United Kingdom	57.1	49.6	111.3	109.7
France	19.0	7.5	37.6	19.5
Belgium	17.4	18.3	34.4	43.0
Holland	21.1	23.1	44.3	53.5
Central Europe[a]	22.3	27.1	49.4	56.6
Italy	36.1	24.6	54.3	44.9
Greece and Turkey	6.3	4.8	11.6	9.8
Scandinavia	6.2	6.6	13.0	13.8
Others[b]	1.9	.6	2.8	1.7

[a] Germany, Poland, Czecho-Slovakia, Austria, etc.
[b] Spain and colonies, Portugal.

Certain contrasts, somewhat obscured because the precise destinations of "orders" shipments are not known, are of interest. Somewhat less wheat has been exported to the United Kingdom this year than last; net import data confirm the shipments data, and show 124 million bushels imported in August–February as against 128 million in the same months of 1926–27.[1] Shipments to France and Italy, especially France, have run appreciably smaller this year than last. Net import data confirm the apparent reduction in Italian shipments; August–February net imports totaled 35.4 million bushels in 1927–28, and 41.4 million in 1926–27. With the crop of 1927 officially estimated as 25 million bushels smaller than that of 1926, smaller imports this year than last are difficult to explain. A larger carryover into the crop year, better quality, and heavy marketings in the first half of the year presumably curtailed imports; but it remains to be seen if total net imports for the year will exceed those of 1926–27. Italian imports tend to become heavier in the second half of the year.

Net imports of France during August–February were reported larger this year than last, 35 million bushels as against 27 million—a picture quite the reverse of that given by Broomhall's data. But the shipments data reflect the actual movement of wheat to France more accurately. The regulations governing partial refund of duty in effect during portions of 1926–27 permitted importers to delay the reporting of imports until wheat had passed into consumption; this resulted in net import figures too low throughout most of 1926–27, too high during late 1926–27 and early 1927–28. French trade reports are unanimous in describing the volume of import trade actually transpiring as far smaller this year than last, though how much smaller cannot be suggested.

The countries of central and northern Europe, on the other hand, have thus far imported more wheat in 1927–28 than in 1926–27—not because crops or carryovers were smaller, but because quality was poorer, and perhaps also because high prices for rye and feed grains have tended

[1] See Appendix Table II for net imports of European countries by months.

to encourage consumption of wheat. Total net imports into Germany, the Scandinavian countries, Belgium, Holland, Switzerland, and Czecho-Slovakia were 138 million bushels in August–February 1927–28 as against 116 million during the same months of 1926–27. So far as can be judged by incomplete data, increased imports into these countries have not sufficed to offset decreases in others; hence for the first two-thirds of the crop year, net exports as well as Broomhall's shipments to European destinations have presumably been smaller this year than last.

Shipments to ex-European destinations, 49.8 million bushels during December–March, were slightly larger than last year's, but 9 million bushels below the shipments for these months of 1925–26, and 17 million below the record post-war shipments of 1923–24. As appears from the following figures, which show in million bushels shipments to the more important importers in December–March and August–March 1927–28 and 1926–27, larger shipments were made to Brazil and the Orient, smaller to Egypt, the East and West Indies and Central America, and Africa.

Destination	December–March (17 weeks)		August–March (34 weeks)	
	1926–27	1927–28	1926–27	1927–28
Brazil	6.6	9.5	14.0	18.0
Egypt	3.4	2.5	6.2	5.4
Orient[a]	9.2	14.6	21.1	21.2
Africa[b]	2.6	2.2	4.3	3.7
Central America[c]	23.3	19.3	35.7	30.4
Others[d]	1.2	1.7	1.4	2.1

[a] China and Japan.
[b] North and South Africa.
[c] Includes West Indies, Venezuela, Dutch East Indies, etc.
[d] Includes Chile, India, Syria, Peru, and New Zealand.

For the August–March period, total shipments have run slightly smaller this year than last, but not so much smaller as seemed probable earlier in the year, when shipments to the Orient, in view of a good wheat crop in Manchuria and large rice crops, promised to fall below those of 1926–27. Apparently Japanese importers have found c.i.f. prices attractive enough to justify some accumulation of wheat stocks, though scanty information renders uncertain any explanation of developments in the Far East.

Sources of Exports

In accord with the good crops harvested in the United States, Canada, and Argentina, and the small crop of Australia, the first three countries provided an exceptionally large proportion—85 per cent—of the world's shipments during December–March. Only in 1922–23, when the Australian crop was as small as in 1927–28, and exports from the Danube basin were even smaller, was the proportion furnished by the two Americas equally high. The data (Broomhall's shipments, with official data for net exports from Canada and the United States) appear in Table 6 (p. 246).

The remaining 15 per cent was provided chiefly by Australia, from which 27.4 million bushels, 10 per cent of the total, were exported—the smallest quantity since 1922–23. India, as usual when the crop is not large, shipped only negligible quantities, and imported a little wheat from Australia. According to Broomhall's data, Russia exported less than a million bushels in December–March as compared with 4.8 million in the same period of 1925–26 and 20.4 million in 1926–27.[1] The causes have apparently been a lack of credit facilities, and a breakdown of the collecting campaign due largely to the unwillingness of peasants to part with wheat while prices of manufactured articles remained disproportionately high, rather than a notably deficient crop or low stocks on farms. Shipments from the Danube countries of 10 million bushels were but slightly smaller than those of 1926–27, despite smaller crops in Roumania and Jugo-Slavia and the absence of any exceptional tendency of importers to seek wheat near at hand to escape high freight rates. The good quality of wheat in the Balkans this year has apparently stimulated exportation, particularly of flour. Roumanian exports may have been stimulated by a reduction of the export tax, effective October 20, 1927, from about 11 to 6 cents per bushel on wheat; the tax on flour was also reduced, and now stands at about 17 cents per barrel.

Shipments from Argentina of 82.3 million bushels were of record size for the second

[1] In these earlier years, some wheat not accounted for by Broomhall was exported overland; but thus far this year the facts, much less the quantities, are not known.

third of the crop year. The previous record was made in 1924–25, when 66.2 million bushels were shipped from a crop nearly 30 million bushels smaller, under the influence of exceptionally high prices. In 1923–24, when the Argentine crop of 248 million bushels was some 9 million larger than the crop of 1927 (as now estimated), low prices and relatively high ocean freight rates served to restrict December–March shipments to 55.9 million bushels. This year the wheat is never exported in volume during the winter on account of closed navigation on the Great Lakes, and since the spread between Chicago and Liverpool futures was almost as far below a shipping difference this year as last, the comparatively small volume of wheat exports from non-Pacific ports this year is to be explained by the higher cash prices of hard red winter and soft red winter wheat. Last year during December–March the average cash prices

TABLE 6.—INTERNATIONAL SHIPMENTS AND NET EXPORTS OF WHEAT AND FLOUR FROM PRINCIPAL EXPORT AREAS, DECEMBER–MARCH 1920–28*

(Million bushels)

Dec.-Mar.	International shipments (Broomhall)							Net exports from	
	Total	North America	Argentina	Australia	Russia, Danube	India	Other[a]	United States	Canada
1920-21	181.4	128.3	16.3	28.2	0.3	8.3	0.0	76.0	75.1
1921-22	223.6	119.5	50.9	44.6	1.4	0.0	7.2	47.3	65.8
1922-23	225.9	139.8	53.0	24.8	1.5	6.6	0.2	49.0	84.3
1923-24	270.1	159.6	55.9	33.3	15.4	0.6	5.3	34.6	117.0
1924-25	272.0	117.0	66.2	60.3	11.4	15.1	2.0	63.4	61.9
1925-26	234.7	128.8	33.1	41.3	7.6	0.0	23.9[b]	21.8	116.4
1926-27	299.1	159.3	61.0	49.3	19.0	0.3	10.2	42.3	100.6
1927-28	272.7	149.3	82.4	27.4	1.7	0.0	11.9	32.1	113.2

* Shipments are for 17 weeks, from Broomhall's *Corn Trade News*. Net exports are official data.

[a] In several years apparently includes some shipments from Russia and the Danube basin. In another table Broomhall gives the following distribution, in million bushels, for 1926–27, Russia 20.4, Danube 10.4, North Africa and Chile 0.4; for 1927–28, Russia 0.8, Danube 10.0, North Africa and Chile 2.0.

[b] Includes shipments from Hungary and Germany.

combination of a large crop harvested under favorable weather conditions, low ocean freight rates, and acceptable prices has caused the largest mid-winter movement in history. Because of its relatively good quality as compared with Canadian, Argentine wheat has been more favored by importers than usual, and forward sales of exceptionally large volume are said to have been made in October–December.

Net exports from the United States in December–March totaled only 32 million bushels as compared with 42 million in 1926–27. The quantity seems small in view of the higher visible supplies and the larger crop this year.[1] Export business in wheat as wheat was practically negligible from the Atlantic and gulf ports of the United States; only 1 million bushels were exported as against 17 million last year. Since spring of No. 2 Red Winter at St. Louis was $1.25 and of No. 2 Hard Winter at Kansas City, $1.36; and parcels prices in the United Kingdom averaged $1.61. This year, with United Kingdom prices averaging only $1.48, No. 2 Red sold for $1.53 and No. 2 Hard for $1.34.[2] Flour, however, was exported in about equal volume in both years. Exports from the Pacific coast in December–March, as the following official data in thousand bushels show, were exceptionally large as a result of the good crop harvested there, though not so large as in 1923–24, when the crop was still larger:

	1923–24	1924–25	1925–26	1926–27	1927–28
Wheat	11,276	2,942	6,139	6,786	10,388
Flour as wheat	13,649	3,765	3,487	3,924	5,852
Total	24,925	6,707	9,626	10,710	16,240

Canadian net exports of 113.2 million bushels were of only slightly smaller vol-

[1] The crop of 1926, however, may perhaps have been underestimated.

[2] See also Charts 3 and 5, pp. 252, 255.

ume than in 1923–24 and 1925–26, but 12.6 million bushels larger than in 1926–27. A somewhat heavier movement both for December–March and for the season as a whole might have been expected in view of the second largest crop in history and a carryover of record size; but the late and wet harvest curtailed exports noticeably in October, and to a lesser extent in November and December as well. Heavy exports in January–March—some 12 million bushels larger than the previous high record for post-war years established in 1925–26—failed to bring the export movement for the season up to the level suggested by the crop and carryover data. The record exportation of January–March, after the closing of lake navigation, was made possible chiefly by the huge crop in Alberta, which made wheat (preferred by European importers over wheat from Saskatchewan and Manitoba because of its better quality) readily available for shipment from Vancouver and Prince Rupert. These ports have shipped 63.0 million bushels of wheat (including flour) in August–March, some 4.3 million more than was shipped in twelve months in 1923–24 and 1925–26, the years in which Pacific coast shipments previously had been the largest. No conclusive evidence appears to demonstrate that the Pool has deliberately restricted the export movement by restricting sales, thus building up stocks to the high level of the last four months.

III. MARKETING AND STOCKS

Except in several countries of western Europe, where wheat prices have been disappointingly low to producers, wheat has apparently moved with normal rapidity from farms to central markets. In Canada, where the early movement was delayed by a late and wet harvest, marketings became exceptionally heavy in December–March. The crop year began with exceptionally high stocks in most positions throughout the world, and this situation has continued. Visible supplies, so far as they are recorded, attained the highest level in history throughout December–March; stocks afloat of only fair size were more than counterbalanced by the exceptionally high figures for the United States and Canada. The large visible supplies of wheat led European millers and bakers, and flour buyers in the United States, to restrict their purchases in the hope of lower prices, until unfavorable crop prospects altered expectations of price declines. Official estimates of Canadian stocks as of March 31 suggest an official underestimate of the Canadian crop. Abnormally low flour stocks in the United States and a relatively low level of milling output during the first two-thirds of the year point to exceptional milling activity in the last third.

European Marketing and Stocks

The movement of wheat from farm to market in 1927–28 appears to have been slow in several European countries, principally because farmers have not been satisfied with current low prices. As a result, country stocks remained somewhat higher than usual, at least where crops were of good size. The situation differs from country to country, however; and at best the available statistical information is scanty.

In England, despite a crop larger than those of the three preceding years, smaller quantities have been marketed. Wheat of poor quality, which constitutes a large proportion of the crop, has not been sought by millers; and prices have been low. From August 1 to the end of March farmers' deliveries of wheat were as follows for the past four years, in thousand bushels:[1]

1924–25....15,162	1926–27....18,320
1925–26....20,121	1927–28....14,262

The movement, however, was more rapid in December–March than in August–November —8,255 thousand bushels as against 6,007 thousand, or 37 per cent larger. Last year, when millers sought wheat near at hand in order to avoid high costs of transportation from overseas sources, December–March deliveries were only 9 per cent larger than in August–November. As of January 1, 1928, farm stocks in England and Wales were estimated (unofficially) as 26.8 million bushels as against 20.9 million last year. Slightly smaller marketing in Jan-

[1] Data from the *Corn Trade News*.

uary–March this year than last imply larger farm stocks at the end of March.

In Germany, as in England, the wheat crop of 1927 was of poor quality and brought low prices, and marketing was slow. Percentages of the winter-wheat crop remaining in farmers' hands and destined for sale were estimated as follows for 1926–27 and 1927–28:[1]

	Nov. 15	Jan. 15	Feb. 15
1926–27	31.3	24.5	16.9
1927–28	45.6	38.3	30.6

The percentages for February 15, applied to the official crop estimates, imply salable farm stocks in mid-February of some 16 million bushels in 1927, and 37 million in 1928.

The collecting campaign in Russia was relatively unsuccessful until about the middle of January; only 126 million bushels of wheat were collected in July–January this year as against 168 million in 1926–27. Various explanations have been advanced, the most significant being the smaller crop; the low prices of wheat and other cereals as compared with animal products, oil seeds, and manufactured products; a general disposition among peasants to build up stocks; a reduction in agricultural taxes, which are payable in money; and ineffective working of the collecting agencies.[2] But for reasons not yet clear collections became very large in subsequent weeks, and were not far below the high figures of 1927 by the end of March. Stocks in the hands of peasants were probably high at the end of March, if the process of accumulation so often noted by observers in the past two years has continued. Whether or not they were as high as in pre-war years is uncertain, especially if pre-war official estimates of wheat production are to be regarded as much too low.

For other countries data on marketing and stocks are even less satisfactory. Danish farmers are reported to have marketed freely from a large crop. In Italy the movement appears to have been rapid until late January, when growers were holding in expectation of higher prices. Except for a brief period in December, French farmers apparently followed the advice of the producers' association—neglected in the first third of the year—and have not pressed their offers; stocks are thought to be above average in size. Dissatisfaction with prices has prevailed in Roumania and Hungary, but since the export movement has been of good volume, there is little reason to suppose that exceptionally large stocks have been accumulated.[3]

Visible Supplies

The unusually large supplies of commercial stocks of wheat have constituted one of the most notable features of the period under review. The principal elements of world visible supplies are shown in Chart 2 (p. 249).

For the past four months the United States visible (Bradstreet's) has run about 20 million bushels larger than in 1926–27, chiefly because of the much larger spring-wheat crop, which is more largely represented in the visible than is the winter-wheat crop.[4] Larger receipts at primary markets[5] and a smaller movement to export in December–March[6] have also contributed to maintain visible supplies at a high level. In March the United States visible reached the highest level since 1919, though for earlier months the level of 1924–25 had been higher than that of 1927–28 on account of heavier marketing in the earlier year. Under the influence of rising prices, marketing during February and March 1928, as indicated by receipts at primary mar-

[1] Unofficial data collected by the Preisberichtstelle beim Deutschen Landwirtschaftrat.

[2] For a more detailed discussion, see *Foreign Crops and Markets*, March 26, 1928, XVI, 399–401.

[3] In Hungary, indeed, the visible supply of wheat and flour has been estimated as 1,972 thousand bushels on January 7, 1928, as compared with the larger figure of 2,032 thousand on January 31, 1927.—*Pesti Naplo*, January 18, 1928. The same source, on March 14, 1928, stated that farmers had little wheat in reserve.

[4] An illustration of the heavy accumulation of spring wheat this year in the visible supply is provided by the following figures which show in thousand bushels as of the end of March for the past six years, wheat visible at Duluth and Minneapolis as compared with the total Chicago Board of Trade visible:

Year	Duluth and Minneapolis	Total United States	Year	Duluth and Minneapolis	Total United States
1923	25,617	45,785	1926	15,852	33,674
1924	20,870	59,549	1927	19,771	48,653
1925	25,669	60,007	1928	41,624	67,364

[5] See Appendix Table V.

[6] See Table 6, p. 246.

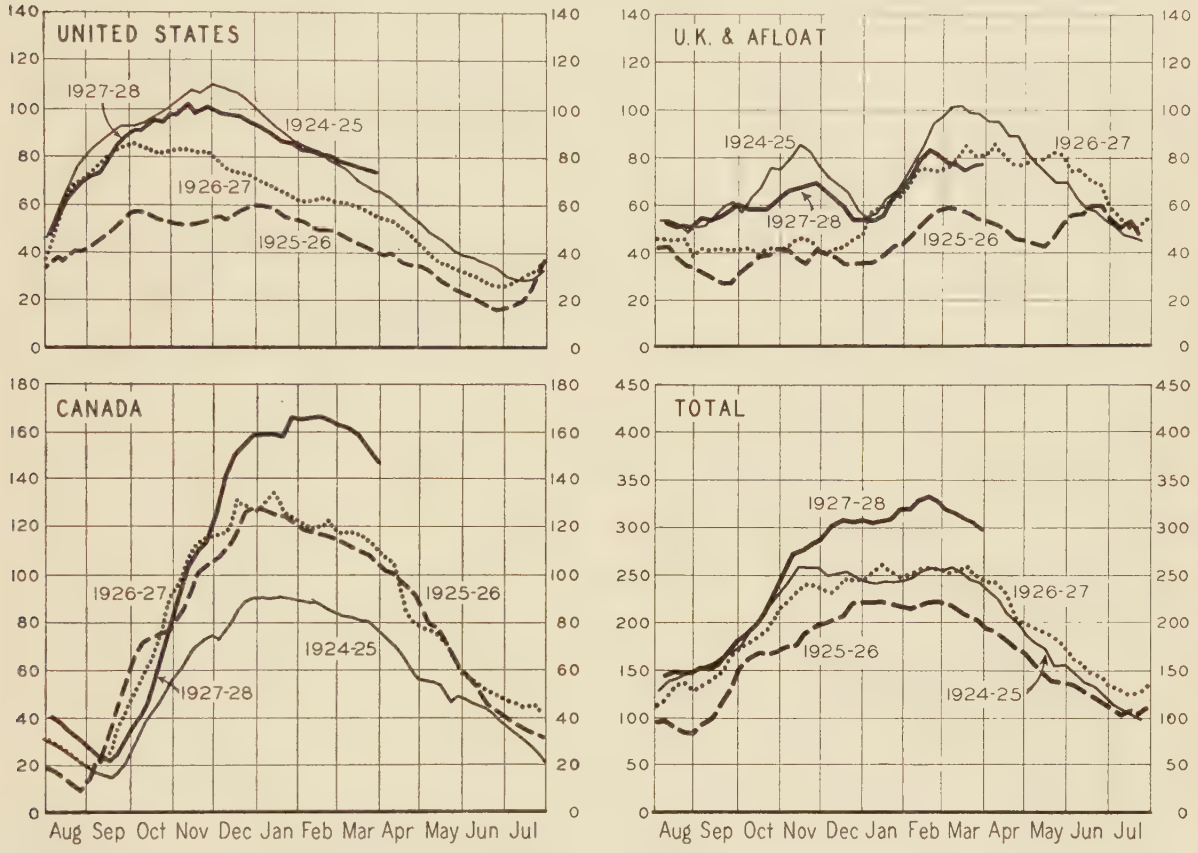
kets, has been the largest in the past five years.

Stocks on farms and in country mills and elevators, officially estimated as 130 and 74.1 million bushels respectively as of March 1, were not so large by contrast with earlier years as was the visible.[1] Stocks on farms were larger in every post-war year except 1919, 1925, and 1926; and stocks in country mills and elevators were slightly smaller than in any other post-war year except 1925. As compared with 1927, stocks both on farms and in country mills and elevators were lower in all regions except the spring-wheat belt and the Pacific northwest.

Canadian visible supplies reached the highest point in history in December, and were maintained above 160 million bushels for seven weeks in January, February, and March. The previous high record was established in January 1924, when visible supplies in Canada were maintained at a level of about 140 million bushels throughout the month.[2] Higher figures in 1927–28 than in the two preceding years were to be expected in view of the larger crop; but the crop of 1923, according to the official estimates, was 34 million bushels larger than the crop of 1927. The abnormally large visible supplies this year as compared with 1923–24 are attributable principally to the delay in harvesting and the retarded movement from farms to terminal markets. Up to December 1, 1927, combined receipts at Fort William, Port Arthur, Vancouver, and Prince

CHART 2.—VISIBLE WHEAT SUPPLIES IN THE UNITED STATES, CANADA, AND UNITED KINGDOM PORTS AND AFLOAT TO EUROPE, WEEKLY FROM AUGUST 1924*

(Million bushels)



* Data from *Price Current-Grain Reporter* and *Canadian Grain Statistics.*

[1] See Appendix Table VIII.

[2] See Chart in WHEAT STUDIES, III, 106.

Rupert were only 151 million bushels as compared with 176 million in 1923. By April 1 the position had been altered, and receipts totaled 278 million bushels as against 277 million in 1923–24; December–March receipts of 127 million bushels were 27 million larger than in 1923–24. The delay in marketing earlier in the season prevented as large a movement to export before the close of navigation as would otherwise have occurred, and exceptionally heavy exportation through Pacific coast ports in January–March did not suffice to reduce visible supplies to a level comparable with that of 1923–24, though such a level or a lower one might have been expected from comparison of the size of crops alone. There is small reason to suppose that the Canadian Pool has this year deliberately restricted sales, at least to any appreciable degree. How much wheat the Pool sold on the futures market during the period of rising prices in February–March, or how much for shipment at the opening of navigation, is unknown; but the trade supposes transactions to have been large. Whether or not the large visibles will eventually prove embarrassing to the Pool depends upon new-crop prospects in the Northern Hemisphere and upon the course of prices during ensuing months. It is possible on the one hand that sales for shipment after the opening of navigation have been and will be so large that a record export will occur in April–July and the carryover out will not prove embarrassing; and on the other hand, if sales have not been exceptionally large and good crop prospects lead European importers to curtail their purchases, exports may be only of average size and the carryover many million bushels larger even than in 1927. In our judgment the former alternative is the more probable.[1]

Stocks afloat for Europe and in ports of the United Kingdom have run only moderately high. These stocks are in large part determined by the volume of shipments from the distant exporting countries, especially Australia and India. In 1924–25 and 1926–27, when stocks afloat for Europe and in ports of the United Kingdom were higher than this year, shipments in December–March from these countries were 75.4 and 49.6 million bushels, respectively, as compared with 27.4 million in 1927–28. Stocks in ports of the United Kingdom,[2] which were reduced to fairly low levels during January and February before arrivals from the Southern Hemisphere became heavy, were increased during March; on April 1 they stood at 7.7 million bushels, about an average figure and well above those of 1927. Although precise information is lacking, roughly the same situation has apparently prevailed in continental ports.

Principally on account of the huge visible supply in Canada, the combined total of visibles in North America, afloat for Europe, and in United Kingdom ports has run over 50 million bushels higher than in any of the past three years and 25–50 million bushels higher than in 1923–24. A different statement, including visible supplies in Argentina and Australia together with some flour stocks in the United States, yields a less marked contrast.[3] As of April 1, world visible supplies aggregated 382 million bushels, the largest in post-war years, but only 38 million larger than in 1927, and 23 million larger than in 1924 and 1925. Relatively small visibles in Australia, the result of a small crop, have in some degree offset the larger visibles in North America. On April 1, 1927, Australian visibles were 53 million bushels, but only 36 million in 1928.

Canadian Stocks and the Crop Estimate

The official estimates of Canadian stocks in all positions as of March 31 showed the largest total in post-war years, 220 million bushels.[4] Last year the figure was 176 million, and 202 million in 1924, when stocks had previously been highest. The data are of interest for their bearing on the accuracy of the official crop estimate of 440 million bushels.

From an apparent total supply of wheat of 488 million bushels (a crop of 440 million plus a carryover of 48 million), 226 million bushels of wheat had left Canada as net exports of wheat and flour between August 1 and March 31. Thus 262 million bushels apparently were available to cover stocks

[1] See above, p. 242.

[2] See Appendix Tables VI and VII.

[3] See Appendix Table VII.

[4] See Appendix Table VIII.

in all positions on March 31, and also to provide for wheat used for food and feed in the eight months ending March 31. Since stocks on March 31 were actually reported as 220 million bushels, a supply of only 42 million bushels was apparently available for use as food and feed during these eight months. Wheat milled for domestic consumption may be estimated at 45 million bushels for the crop year; two-thirds of this quantity, or about 30 million bushels, had presumably been consumed in August–March. Hence only 12 million bushels would remain to cover unmerchantable grain, grain lost in cleaning, and merchantable grain fed on farms. Unmerchantable grain has been officially estimated as 6 per cent of the crop, or 26.4 million bushels, and grain lost in cleaning as 3 per cent of the crop, or 13.2 million. If, as seems reasonable, two-thirds of each of these quantities, a total of 26.4, had been consumed by March 31, and only 12 million bushels were apparently available to cover not only these items of disposition, but also the quantity of merchantable wheat fed on farms, the evidence suggests that the standing crop estimate is somewhat too low.

United States Flour Stocks and Their Significance

Stocks of flour in the United States appear to have been extremely low on March 1. Stocks in distributive channels March 1, at 6,970 thousand barrels (Russell's estimate), were at about the usual level for the season, but stocks elsewhere appear to have been below the low point of last July.[1] Mill output during the eight months of July–February was about 80.2 million barrels, while net exports (calculated to include shipments to possessions) were 9.7 million barrels. The balance remaining for domestic consumption falls about one million barrels short of our estimate (71.7 million barrels) of the actual consumption for the period. On this calculation, total flour stocks in the country March 1 appear to have been about one million barrels lower than on the previous July 1.

This situation contrasts sharply with that of the previous four years, as shown in the accompanying tabulation, in million barrels:

July–February	1923–24	1924–25	1925–26	1926–27	1927–28
Output	83.6	85.3	81.2	83.1	80.2
Net exports[a]	12.9	10.4	7.1	9.9	9.7
Domestic disappearance	70.7	74.9	74.1	73.2	70.5
Consumption	67.7	68.4	69.4	70.4	71.7
Remainder (apparent increase in stocks)	+3.0	+6.5	+4.7	+2.8	−1.2

[a] Includes shipments to possessions.

With full allowance for possible error in the estimates of flour output and of consumption, there still appears to be no ground for supposing that total flour stocks in the United States on March 1 were materially above the low level usually reached only in midsummer. There is therefore little possibility of further reduction in flour stocks; and mill output during March–June must provide for nearly the full amount of domestic consumption and net exports, probably in the neighborhood of 40 million barrels. This would require in the neighborhood of 187 million bushels of wheat, some 19 million bushels more than were milled in the same four-month period of last year.

IV. WHEAT PRICE MOVEMENTS

The Level of Wheat Prices

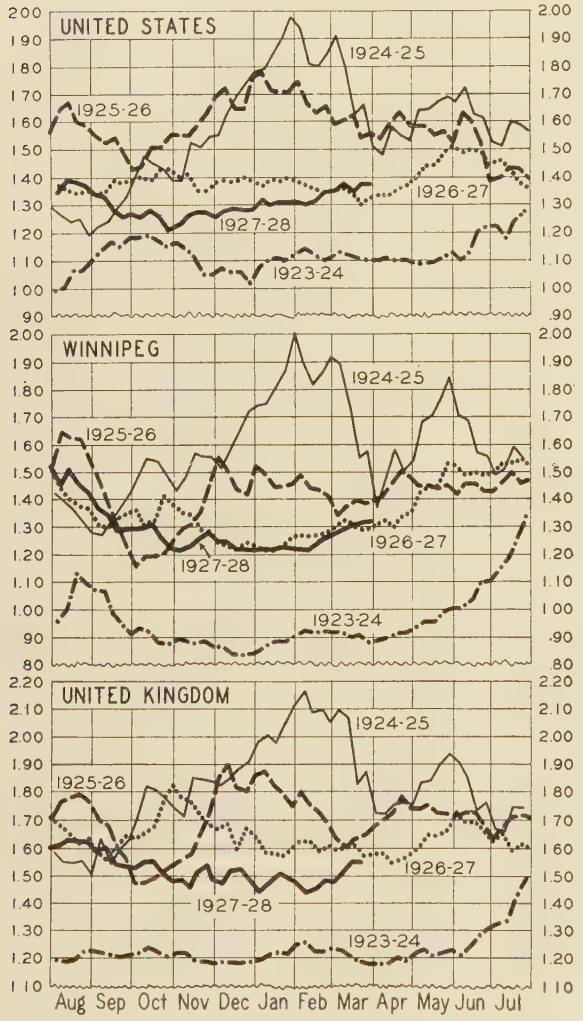
Levels of cash wheat prices in December–March 1927–28, by comparison with the levels of earlier years, have shown strikingly different relationships between different countries and for different types and grades of wheat. Chart 3 shows weekly comparisons of parcels prices in the United Kingdom, of weighted average prices in United States markets, and of the prices of No. 3 Manitoba Northern at Winnipeg for the past five years. English (and presumably continental) importers have been able to obtain wheat at an average price lower than in any of the past five years except 1923–24, some 13 cents per bushel lower than in 1926–27. Monday quotations of

[1] See Appendix Table IX.

standard straight-run flour in London during December–March averaged $7.09 per barrel, as against $6.66 in 1922–23, $5.76 in 1923–24, $9.08 in 1924–25, $8.19 in 1925–26,

CHART 3.—WEEKLY AVERAGE CASH PRICES OF ALL CLASSES AND GRADES OF WHEAT IN FIVE PRINCIPAL UNITED STATES MARKETS, OF NO. 3 MANITOBA NORTHERN IN WINNIPEG, AND OF SALES OF PARCELS OF ALL CLASSES OF WHEAT IN THE UNITED KINGDOM, FROM AUGUST 1923*

(U. S. dollars per bushel)



* Data from *Crops and Markets, Canadian Grain Statistics,* and *London Grain, Seed and Oil Reporter.* United States prices are weekly weighted averages from six markets since the first week in January 1927.

and $7.65 in 1926–27. This flour is made from wheats of various types and grades, so blended as to result in a flour of uniform quality produced at the lowest possible cost; its price constitutes in a sense an accurately weighted wheat price. Lower wheat and flour prices in the United Kingdom this year than last bear witness to a slightly easier international statistical position—a position distinctly easier than in 1924–25 or 1925–26, but not so easy as in 1923–24.

Nevertheless, available data suggest that wheat prices in exporting countries have not been so far below last year's as was true in the United Kingdom. No. 3 Manitoba Northern at Winnipeg has sold at almost the same prices this year as last. No. 1 Manitoba brought even higher prices, and has been so scarce that spot prices at Liverpool have not been quoted for many weeks of the period. Barletta wheat at Buenos Aires was only 2–4 cents cheaper in 1927–28 than in 1926–27. In the United States, No. 2 Hard Winter brought, on the basis of monthly averages of weighted weekly prices, only 2–6 cents less per bushel in December–February this year than last, and sold for higher prices in March. No. 2 Red Winter at St. Louis has been appreciably dearer. No. 1 Dark Northern at Minneapolis was cheaper by 4–11 cents this year than last until March; but this grade, like No. 2 Amber Durum, which has been over 30 cents per bushel cheaper this year, is exported to the United Kingdom in quantities too small to affect the price of parcels there. Australian wheat prices were apparently quite as high this year as last in view of the smaller crop.[1] So far as can be ascertained, cash wheat prices in exporting countries, with the possible exception of spring and Pacific wheats in the United States, seem to have been relatively higher by comparison with cash prices last year than has been true in the United Kingdom.[2]

This circumstance seems explicable only by reference to lower ocean freight rates during December–March 1927–28 than in the corresponding period of 1926–27, when the effects of the British coal strike were still in evidence. For this period of 1926–27 and December–February 1927–28, averages

[1] Based on prices of bagged wheat per bushel at country points, as given in *The Land.* In January–February 1927, prices ranged from 4*s.* 5*d.* to 4*s.* 9½*d.*; in the same months of 1928, from 4*s.* 5*d.* to 4*s.* 9*d.*

[2] For the price comparisons upon which the above paragraph is based, see Chart 5 (p. 255), and Appendix Table X (cf. Appendix Table XI in WHEAT STUDIES, III, 298).

of Friday rates on four important export routes were as follows, in cents per bushel.[1]

	1926–27	1927–28
Northern Range to U. K....	10.0	7.0
Northern Pacific to U. K...	25.1	20.0
La Plata down river to U. K.	20.8	13.9
Australia to U. K.....	31.8	22.5

Lower ocean freight rates this year than last have apparently reduced the spread between export and import prices of wheat; but to whose advantage, it is impossible to say. Had ocean freight rates remained at last year's level, cash wheat prices in the United Kingdom might have ruled above the level that has actually prevailed, while cash wheat prices in exporting countries remained the same; or export prices might have proved lower, and import prices the same. The truth perhaps lies somewhere between the two extremes.

In the major importing countries of Europe, prices of domestic wheat, as compared with the prices prevailing in the second third of 1926–27, have been extraordinarily low.[2] December–February prices this year and last averaged as follows, in terms of gold dollars:

	1926–27	1927–28
Great Britain.....	$1.55	$1.28
France	1.82	1.57
Italy	2.18	1.92
Germany	1.73	1.51

These reductions, 20 cents per bushel or more in each country, cannot be explained simply by reference to lower prices of import wheats, which (in Great Britain at least) have averaged only about 10–13 cents lower than in 1926–27. There have been no reduction of tariff duties; in France, indeed, the duty has been higher this year than last. In France, Germany, and England larger crops of wheat containing higher proportions of poor-quality grain apparently explain the situation. Domestic wheat has been not only more plentiful but also less satisfactory for milling. In Italy, however, where the crop was estimated some 25 million bushels smaller in 1927 than in 1926, and quality was better, this explanation fails. There was a large carryover into the crop year; marketings (partly from the carryover) appear to have been exceptionally heavy in the first half of the year; and millers have not been forced to bid up prices in order to obtain ample supplies.

These relationships aptly illustrate the need for qualification of statements respecting the level of "world" wheat prices in different years. Thus far in 1927–28 wheat prices in general have ruled unmistakably lower than in 1926–27. But relative cheapness is most obvious with respect to domestic wheats in western Europe; it is unmistakable but less marked with respect to import wheats in the United Kingdom; it is fairly clear in the United States, though not for all varieties and grades; and it is scarcely perceptible in Canada, Argentina, and Australia.

The Course of Prices

Chart 4 shows the course of futures prices in the world's leading markets. As we anticipated in our December survey, fluctuations were small until prospects for new crops began to exert an influence—this year, as it happened, as early as mid-February. Throughout December and January, prices of the May future fluctuated within a 7-cent limit in Chicago, and within a narrower limit still in Liverpool and Winnipeg. Feeling themselves secure in the face of the largest visible supplies in history, European importers pursued a policy of leisurely though by no means niggardly purchasing. Speculative activity in the United States, as evidenced by the volume of futures trading, was at the lowest level since 1923–24, and practically as low as in that year until a revival occurred in March.[3] In late January and early February futures prices declined about 6 cents per bushel in Liverpool as purchasing continued inactive and large shipments were made from Argentina; but this decline was not followed to its full extent in other markets.

After the first week in February, prices

[1] Computed from Friday rates published in *International Crop Report and Agricultural Statistics.* The 1927–28 average does not include the last two weeks in February.

[2] See Appendix Table XI.

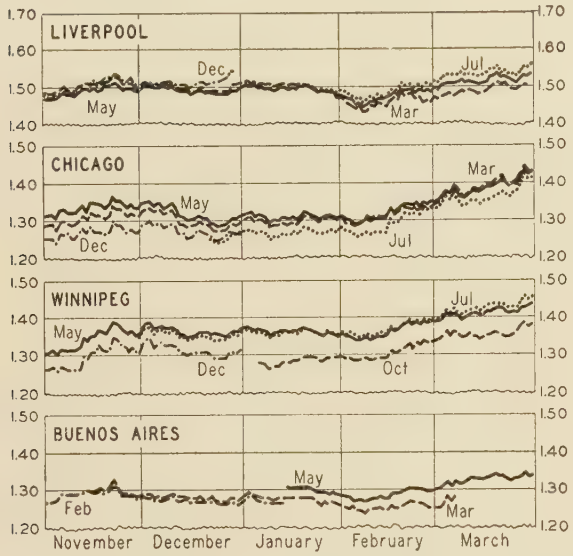
[3] The average daily volume of trading in wheat futures in all United States markets from December to March 1923–24 to 1927–28 has been as follows in million bushels:

	December	January	February	March
1923–24.....	21.1	14.3	18.1	22.8
1924–25.....	58.8	73.4	81.0	87.4
1925–26.....	90.3	60.6	58.3	69.0
1926–27.....	37.4	28.2	26.4	34.1
1927–28.....	20.9	15.4	22.1	34.2

in all markets tended definitely upward. The February–March advance was most extreme in Chicago, where the May future advanced 15 cents from February 4 to March 31. In Winnipeg the advance amounted to 10 cents; in Liverpool, to 9 cents; in Buenos Aires, to 7 cents. The principal cause of the advance was the increasingly unfavorable outlook for winter-wheat crops, chiefly in the United States east of the Mississippi, but also in western Europe.

CHART 4.—DAILY CLOSING PRICES OF PRINCIPAL WHEAT FUTURES IN FOUR LEADING MARKETS, NOVEMBER–MARCH 1927–28*

(U. S. dollars per bushel)



* Data from *Chicago Journal of Commerce* and *Daily Trade Bulletin*, Chicago.

Partly because of the new-crop outlook, but also because stocks of import wheat were being depleted, European purchasing became active in early February. Rumors—officially denied the next day—that Russia was upon an import basis were circulated on February 16, and tended to strengthen prices. In the United States milling demand for cash wheat strengthened perceptibly as milling activity increased from the abnormally low seasonal levels of the winter months.[1] Throughout March the evidence of excessive winterkilling and low condition of the soft red winter-wheat crop in the United States became increasingly convincing, and dominated world price movements. Speculative buying increased in volume.

The upward movement of prices was continued and indeed accelerated in April. Private reports on condition issued around the first of the month were regarded as bullish; the official report issued April 10 even more so. By April 27 the May future at Chicago sold for $1.64, fully 39 cents above the low point reached on December 24; and the July option was only a trifle lower. Apparently this considerable increase occurred almost entirely on the strength of unfavorable reports of winter-wheat prospects in the United States alone. Futures prices in Winnipeg and Liverpool failed to follow the advance in Chicago to its full extent, despite an adverse spring in Europe.

UNITED STATES CASH PRICES

Cash prices of representative wheats in the United States during December–March, as shown in weekly averages in Chart 5, have fluctuated more widely than futures prices, or than cash prices in 1926–27. No. 2 Amber Durum, chiefly on account of the larger crop, has continued to sell at prices much below those of last year, and (except for a period in December and early January) below the prices of other grades shown in the chart. The relative positions established in September prevailed in subsequent months. No. 2 Red Winter has maintained and increased its premium over No. 1 Dark Northern; and the latter has sold at higher prices than No. 2 Hard Winter. In March No. 2 Red Winter rose to the highest premium over No. 1 Dark Northern recorded in the past three years; in the last week of March the spread was 29 cents per bushel, as compared with 17 cents in the last week of January 1926, when the spread was previously widest. Like futures prices, cash prices of all four grades advanced rather sharply after mid-February. The relatively sharper increase of prices of No. 2 Red Winter reflects the fact that the soft red winter-wheat region suffered more than other regions from unfavorable winter weather.

A significant feature of cash prices during the period has been the emergence of abnormally high premiums for protein content. This may be illustrated by reference

[1] See above, p. 251.

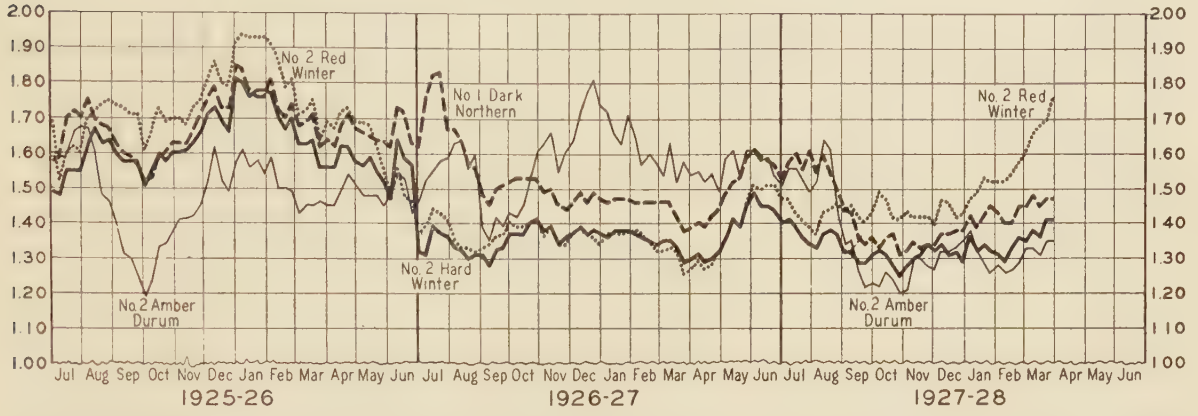
to the average daily range of cash sales prices of No. 1 Dark Northern spring wheat at Minneapolis for a single week in February in each of the past six years, in cents per bushel:[1]

Week ending	High	Low	Range
February 17, 1923...	142.5	123.5	19.0
February 16, 1924...	130.3	118.2	12.1
February 14, 1925...	185.2	181.6	3.6
February 13, 1926...	182.3	164.2	18.1
February 12, 1927...	150.6	142.5	8.1
February 11, 1928...	172.4	126.2	46.2

Figures for a single week may be regarded as reasonably representative; it is clear that protein premiums have run over 100 per cent higher than in any of the past five years. Approximately similar conditions have prevailed with respect to hard red and soft red winter wheats. The exceptionally wide range of prices within a grade suggests that fluctuations in weekly average prices may have been rendered unusually wide by variation in the quality of wheat sold in different weeks. Millers, measuring from 11 per cent protein content as a base, have paid as much as 10 cents per bushel premium for each additional per cent. So fine a price adjustment for protein content seems over-precise in view of the probable margin of error involved in the methods of sampling and of chemical analysis.

CHART 5.—WEEKLY AVERAGE CASH PRICES OF TYPICAL WHEATS IN UNITED STATES MARKETS, FROM JULY 1925*

(U. S. dollars per bushel)



* No. 2 Red Winter at St. Louis, No. 2 Hard Winter at Kansas City, No. 1 Dark Northern Spring, and No. 2 Amber Durum at Minneapolis. Data from *Crops and Markets.*

V. PROSPECTS FOR 1928 CROPS

Prospects for world wheat supplies in the coming crop year 1928–29 are of course uncertain so early in the season, with nothing definite known of next winter's crop in the Southern Hemisphere, where seeding has not yet begun. The seeding of spring wheat in the Northern Hemisphere is not yet complete; and harvest of winter wheat is still from one to four months distant in Northern Hemisphere countries except India. India and North Africa, however, bid fair to secure slightly larger crops in 1928 than in 1927. Despite an unfavorable winter, Europe may harvest a crop of millable wheat as large this year as last, in view of a larger area sown and the abnormally unfavorable harvesting weather in 1927. In the United States early prospects for winter wheat are less favorable than last year, and the crop now promises to be smaller. If spring-wheat crops equal to the average for the past six years are harvested in the United States and Canada (at present a fairly reasonable expectation), the Northern Hemisphere crop of 1928, exclusive of Russia, China, and Asia Minor, will probably prove smaller than that of 1927. But since a crop of average size is seldom har-

[1] Data from *Daily Market Record.* "High" and "low" figures represent averages of high and low cash sales reported daily, not the highest and lowest single sales reported in the course of each week.

vested in a particular year, even so much cannot be said with assurance.

India and North Africa

The first to be harvested of the wheat crops of the Northern Hemisphere, those of India and North Africa, promise to be above average in size. In India the second official estimate of area sown, 31,332 thousand acres, was a few thousand larger than the final estimate of acreage in 1927. The winter rainfall, though somewhat late, appears to have been ample; and by mid-March crop condition was reported above average on irrigated areas and average on unirrigated areas. Damage by rust and pests seems not to have become serious, though considerable damage is reported from the United Provinces. A crop equal to or larger than the moderate yields of 1926 and 1927 is in prospect. Exports, moderate in volume unless the crop proves distinctly large, may be anticipated in June and July.

Torrential rains in many parts of the French dependencies in North Africa occurred in December and to a lesser extent in the following months, and growing plants were somewhat damaged. Sowings were for a time retarded by flood conditions in Morocco and Algeria, for which official February estimates of acreage sown were slightly lower than in the past four years, though in Tunis the acreage was reported well above average. For the three countries combined, a net increase over 1927 of half a million acres is reported, and late sowings may have augmented the increase. The ample subsoil moisture already provided by the heavy winter rains may, under normal growing conditions, result in a crop above average in size, and perhaps larger than the crop of 1927.

Europe, Including Russia

In the absence of reasonably complete information on the sowing of spring wheat and the extent of abandonment of winter wheat in European countries, little can be said regarding the probable acreage remaining for harvest in 1928. The United States Department of Agriculture reports the area sown to winter wheat in nine European countries, including France, Spain, Italy, Roumania, and Bulgaria, as 49,886 thousand acres as compared with 49,128 thousand in 1927; the figure differs but slightly from the acreages of 1925 and 1926. Increases have probably occurred in most countries of western Europe except England and Germany, where wet weather delayed seeding. For Russia,[1] despite fears of greatly reduced acreage in earlier months on account of drought in some regions during the seeding season, a preliminary official inquiry made in February indicated an increase over 1927 of 8.7 per cent in the Ukraine and a decrease of 5.3 per cent in North Caucasia, districts which include about 75 per cent of the Russian winter-wheat acreage. An official estimate issued in March placed the area sown in all Russia at 27,794 thousand acres, an increase of 737 thousand over the area sown for the crop of 1927.. Wheat sowings are reported to have been increased at the expense of rye and barley.

A heavier abandonment than in 1926–27 seems probable for Europe ex-Russia as a whole, perhaps sufficient to offset the apparent increase in acreage. Last year the winter was exceptionally mild and damp. This year an extreme cold wave toward the end of December in central and western Europe injured the growing crop especially in France, where snow cover was deficient, and to lesser extent in Austria and Germany. In early March a second cold wave, in the absence of snow cover in many localities, was injurious throughout central Europe and the Danube countries. Thus far it seems probable that abandonment has been heaviest in France, lightest in Italy. In several countries condition is lower than in 1927 and spring is late. Yet weather in the later growing season and at harvest is important for European crops, as appears from the course of developments last year. In view of the large acreage sown, there is reason to anticipate for 1928 a harvest within the range of 1,200–1,275 million bushels, like those of 1921, 1923, 1926, and 1927, rather than a poor crop of 1,000–1,050 million like those of 1922 and 1924, or a bumper crop of 1,392 million as in 1925.

[1] See *Foreign Crops and Markets*, March 26, 1928, XVI, 391 f. This issue contains a valuable review of the agricultural situation in Russia.

But present expectations will be modified by the weather conditions.

Information on abandonment and crop developments in Russia is scanty; but a late spring, as in other European countries, has not been beneficial. Spring-wheat acreage, which constitutes a larger proportion of the total wheat acreage than in any other European country, has not yet been reported. Soviet officials are reported to have made great efforts to insure a large acreage of spring-wheat sowings.

United States Winter Wheat

The outlook for the winter-wheat crop in the United States at this season is as usual uncertain. The area sown last autumn for the crop of 1928, officially estimated in December as 47.9 million acres, was the largest since 1923, distinctly smaller only than the area sown for 1919, and some 4.4 million acres larger than last year. The increase occurred chiefly in the soft red winter-wheat belt east of the Mississippi. In the six leading states of this region the area sown in the fall of 1927 was over 3.5 million acres larger than in 1926 or 1925. Condition for the United States on December 1 was reported as 86 per cent, as compared with 81.8 in 1926 and a ten-year average of 84 per cent. But estimates of acreage sown are sometimes subject to extensive revision,[1] and condition before the onset of winter has little relation to production in the ensuing summer.

On the whole the winter was not favorable and increasing complaints of damage and unsatisfactory condition constituted the most important single influence on the course of prices. In January insufficient moisture was reported in an area including parts of Kansas, Colorado, Oklahoma, and Texas, but subsequent rainfall, particularly in mid-February and mid-March, was distinctly beneficial. In early April conditions were generally regarded as favorable in these important producing states; but the supply of subsoil moisture is not satisfactory. The Pacific coast area enjoyed ample rainfall and apparently suffered no more than normal winterkill; in April prospects were deemed satisfactory, but not so promising as in the spring of 1927. In the soft red winter-wheat belt, especially Ohio, Illinois, Indiana, and Missouri, all indications point to exceptionally heavy abandonment on account of alternate freezing and thawing weather, without snow cover, practically throughout the winter months. Murray's April estimate of abandonment in states east of the Mississippi was 38 per cent; if such large an abandonment is confirmed by the official inquiry in May, it will nearly equal the record abandonment of 1912.

Private estimates of condition in per cent of normal, abandonment in per cent, and production in million bushels, for the United States were made as follows as of the end of March, with comparable figures for 1927:

	Condition		Abandonment		Production	
	1927	1928	1927	1928	1927	1928
Bryant	96.9	72.2	....	....	584	556
Cromwell	85.2	76.2	....	....	576	529
Murray	87.1	73.7	6.4	19.9	585	543
Snow	85.8	72.8	....	....	584	520

The official report, issued April 10, placed winter-wheat condition for the United States as a whole at only 68.8 per cent, as compared with 84.5 per cent in 1927, 84.1 per cent in 1926, 68.7 per cent in 1925, and the ten-year average of 81.9 per cent. The figure was the lowest since 1879, except for 1917 and 1925.

Estimates both of acreage sown, abandonment, condition, and production, issued so early in the season, must be regarded as imperfect indicators of final production. In 1917, for example, condition on April 1 was only 63.4 per cent and 28.9 per cent of the area was abandoned; but yield per acre was 15.1 bushels. In 1925, on the other hand, April 1 condition, 68.7 per cent, was higher and abandonment of 21.6 per cent was lower; yet yield per acre was only 12.9 bushels. In so far as crop developments in these two years provide a criterion, production (calculated on the doubtful assumption that the official estimate of area sown will remain unchanged and that Murray's estimate of abandonment will be precisely substantiated) might vary from 495 to 580 million

[1] Last year, for example, the first official estimate of winter-wheat sowings, as issued in December 1926, was 41.8 million acres; this was subsequently revised upward to 42.8 million in July, and was finally placed at 43.5 million in December.

bushels. If the area sown for the crop of 1928 proves larger and the abandonment smaller than present indications suggest, and yield per acre proves as favorable as in 1917, the crop might equal or exceed the record post-war crop of 627 million bushels in 1926; if area sown proves somewhat smaller and abandonment larger, the crop may prove smaller than any post-war crop except that of 1925. In the face of these uncertainties little can be said with assurance. Official estimates of area sown seem unlikely to be revised downward; spring condition was at least slightly better than in 1917 or 1925; but the cold weather in April has not promoted growth. A winter-wheat crop about average in size is reasonably in prospect under average weather conditions during May, June, and July; and a crop of large size is possible only if the most favorable weather conditions prevail through harvest. Even with the most unfavorable weather experienced in two decades, a crop as small as that of 1925 is unlikely.

North American Spring Wheat

The outlook for wheat production in the spring-wheat belt of North America is of course even more uncertain than for winter wheat at this season, when seeding operations are not yet complete. Present indications favor the expectation of good crops, but developments during the growing season, now unpredictable, may alter the outlook greatly in either direction.

The supply of subsoil moisture in both the United States and Canada is generally regarded as satisfactory as a result of heavy rains in the autumn and ample snow in the winter. Reports from crop correspondents to the *Price Current-Grain Reporter* on soil conditions, published March 28, were as follows in the important producing states, in percentages:

	Favorable	Too wet	Too dry
Minnesota	100	..	..
Montana	100	..	..
North Dakota	71	15	14
South Dakota	100	..	..

During April, however, reports of unfavorably dry soil conditions were circulated from parts of the Dakotas.

In the United States, however, farmers were officially reported to have expressed, as of March 1, intentions to plant only 98.5 per cent of the acreage sown to spring wheat in 1927. An increase was indicated for durum wheat, a decrease for other spring wheats. The upward course of prices during March suggests that (weather conditions permitting) a decrease in area sown is improbable despite announced intentions. In Canada, under average weather conditions, an area larger than that of 1927 will probably be sown; last year sowings were restricted by unfavorable weather.

Up to the date of writing (April 25), no indication has yet appeared of a seriously delayed sowing season like that of 1927. Seeding was begun in the southern extremities of the spring-wheat belt in the last week of March, though there was some delay from cold weather in mid-April. Thus far little reason appears for anticipating from this particular cause an advance of prices such as occured a year ago in May and early June. The completion of seeding in Canada at a normal date would diminish, though by no means eliminate, the probability of damage by rust and frost which unsettled world markets in June–August 1927.

VI. OUTLOOK FOR TRADE, PRICES, AND CARRYOVERS

Changes in new-crop prospects, which cannot now be foreseen, will as usual exert a profound influence on wheat price movements in the ensuing four months of the crop year. In turn, price movements may be expected to affect the volume and course of trade as well as year-end stocks, though to a lesser degree than crop prospects bid fair to affect prices. Nevertheless certain probabilities and possibilities may be mentioned, especially with respect to the more stable elements of the situation.

International Trade

The volume of international trade, as measured either by Broomhall's shipments or by net exports, promises to be large in April–July, but not so large as in 1927. As compared with last year, considerable reductions are probable in the net exports of

the United States, Australia, and Russia; Argentina and the Danube countries seem likely to export a little less. Chile and India may export a little more; and Canada promises to export much more—probably the largest quantity in history, unless the Pool decides to build up stocks to extreme heights. Canada, the United States, and Argentina will presumably continue to furnish a record proportion of the world's exports, as they have done in the first two thirds of the crop year. A peak of shipments is to be expected in late April or early May after the opening of navigation on the Great Lakes; for several weeks total shipments may equal even the high figures recorded at this season last year. Exports from the United States will probably consist chiefly of flour, durum wheat, and Pacific wheat. Little soft or hard red winter wheat is available, and their prices have been too high in recent months, and promise to continue so, to permit appreciable exports; and hard red spring wheat seldom moves to export except in the autumn.

Outward Carryovers

As we have previously pointed out, any calculation of year-end stocks in the major exporting countries must rest upon assumptions regarding crop estimates, the course of trade, and domestic disappearance; and to a considerable extent stocks must be calculated as residual items of disposition.[1] Appendix Table XII presents reasoned estimates of the disposition of wheat supplies in the four major exporting countries, including our estimate of carryovers, for the current and the four preceding crop years. The total carryover in these four countries and afloat for Europe now bids fair to approximate that of 1927, and clearly to exceed any other outward carryover in the period 1922–27 except that of 1923–24.

Little can be said of European stocks of domestic wheat. Russia, despite smaller exports this year than last, has had less wheat available for stock-building; and consumption, both in the aggregate and per capita, apparently increases annually. Whether or not any further accumulation has been made in the course of the year is uncertain, though accumulation seems more probable than depletion. In the Balkan states and Poland stocks promise to remain at a low level. A smaller crop and smaller imports thus far this year than last suggest that Italian stocks may be reduced to a lower level than in 1927. Throughout most other countries of western Europe the recent advance in prices would tend to encourage marketing from farms of the relatively heavy stocks previously accumulated; but, unless imports prove considerably smaller than other evidence suggests, stocks of domestic wheat in all positions promise to remain at fairly high levels. Stocks of import wheat in Europe and stocks afloat for Europe will perhaps prove somewhat smaller than in 1927, in view of a smaller probable movement from exporting countries in the closing weeks of the year; but, since the export movement depends to a considerable extent on prospects for an early or late harvest in Europe, the outlook is not clear.

Australian and Argentine year-end stocks appear to vary but little from year to year, and in any event must be calculated as residual items of disposition. In the two countries combined we anticipate stocks of about the size of those of 1927. For reasons set forth in preceding pages,[2] a carryover of record size, but not far above that of last year, may be accumulated in Canada.

A satisfactory basis for estimating United States stocks on July 1 is difficult to obtain. In the light of past experience the accuracy of the standing crop estimate is problematical, and not enough is known of the quantities of wheat used for feed and waste to justify a direct estimate of this item in dispositon. A large error might appear if the figure for July 1 stocks is calculated as a residual—crop plus carryover in, minus the sum of estimated consumption for food, net exports, seed, and feed and waste. A more reasonable approach is to find an acceptable method of estimating July 1 stocks from March 1 stocks. On the assumption that average reduction (1920–27) from the March 1 level is to be expected for stocks on farms, in country mills and elevators, and visible (Bradstreet's), the total of these items might be expected to reach 92 million bushels on July 1, 1928. This assumption appears to provide as satisfactory a basis as any for estimating July 1 stocks in coun-

[1] See Wheat Studies, III, 290.

[2] See above, pp. 242, 250.

try mills and elevators and visible, in the absence of more refined procedures.[1]

The other large item in the total carryover is stocks held by city mills. With the extraordinarily high protein premiums now prevailing, and the May option running only slightly above the July and September, little reason appears for mills to carry large stocks into the new crop year. We are tentatively disposed to estimate city mill stocks on June 30 at 50 million bushels, some 16 million lower than in 1927, but higher than in 1925 and 1926. Hence total stocks on July 1 appear likely to approximate 142 million bushels, slightly more than the reported figure for last year, and 13 million below our estimate published in December. We regard the figure merely an approximation to the middle of a range; but it now appears unlikely that the final estimate will prove more than 10 million bushels lower or higher. If the total carryover reaches about 142 million, there is reason to believe that the crop estimate for 1927 now standing is not seriously to be questioned.

The Price Outlook

Evidence that unfavorable prospects for new crops may lead to sharp fluctuations in prices even in the face of relatively large visible supplies and a fairly easy statistical position appears in the course of events both during April–July 1927, and during February–April 1928. Last year delayed seeding in the North American spring-wheat belt was the principal cause of a sharp advance in prices from their mid-winter level; this year the situation in the winter-wheat belt both of Europe and of the United States has led to an even sharper advance. As yet it seems impossible to foresee weather conditions more than a few days in advance. Yet in the United States there appears at least a reasonable probability that condition in the soft red winter-wheat belt may improve rather than deteriorate; for condition has been low largely in the absence of normally warm weather, and the ample supply of subsoil moisture would prove conducive to more satisfactory growth. Much the same may be said of Europe. But in parts of the American southwest the crop apparently requires frequent rains because subsoil moisture is not abundant; and the market may be expected to react sharply to reports from that region of drought and hot winds. The outlook for the North American spring-wheat crop is not at present dark; it may progress favorably, or may be jeopardized by drought, rust, or frost later in the season. In the presence of these uncertainties, price fluctuations promise to prove wide during April–July, and especially so in the United States.

In our judgment, however, a decline from the high level of futures prices (Chicago) reached in the week of April 23–28 is somewhat more probable than a further increase. After a period of dullness in mid-winter, the markets apparently responded eagerly to reports of crop damage rather localized than world-wide. Speculative support has perhaps been afforded which cannot be expected to continue long if growing conditions become normal. It now seems probable that only a continuation or further development of distinctly unfavorable crop prospects will maintain prices at their level of April 23–28, or cause a further increase; normal progress of winter- and spring-wheat crops would presumably result in some decline, distinctly good progress in a considerable decline. In view of favorable supplies of subsoil moisture in almost every country and locality except parts of the American southwest, normal or good growth of wheat not already abandoned is more probable than bad. But the probability is by no means a clear certainty; and, though higher prices now seem improbable, they are by no means impossible.

[1] Different bases for estimating farm stocks indicate that July 1 farm stocks this year might be expected to vary between 25 and 31 million bushels. The difference in the estimate of total stocks involved by using either of these figures is at most 7 million bushels, not a large quantity in a calculation where the margin of error is necessarily wide.

This issue is the work of M. K. Bennett, with the advice of Alonzo E. Taylor and Holbrook Working, and the aid of Margaret Milliken, Janet Murray, and Katharine Merriam

APPENDIX

TABLE I.—WHEAT PRODUCTION IN PRINCIPAL PRODUCING AREAS, 1920–27*

(Million bushels)

Year	United States	Canada	India	Australia	Argentina	Chile	Uruguay	Hungary	Bulgaria	Jugo-Slavia	Roumania	Soviet Russia	Mexico
1920.....	833.0	263.2	377.9	145.9	156.1	23.2	7.8	37.9	30.0	43.0	61.3	.....	15.0
1921.....	814.9	300.9	250.4	129.1	191.0	23.6	10.0	52.7	29.2	51.8	78.6	.....	5.1
1922.....	867.6	399.8	367.0	109.5	195.8	25.9	5.2	54.7	32.6	44.5	92.0	.....	13.6
1923.....	797.4	474.2	372.4	125.0	247.8	28.1	13.3	67.7	29.1	61.1	102.1	.....	13.7
1924.....	864.4	262.1	360.6	164.6	191.1	24.5	9.9	51.6	24.7	57.8	70.4	.....	10.4
1925.....	676.4	395.5	331.0	114.5	191.1	26.7	10.0	71.7	41.4	78.6	104.7	713.0	9.4
1926.....	831.0	407.1	324.7	160.9	220.8	23.3	10.2	74.9	41.1	71.4	110.9	809.6	10.2
1927.....	871.7	440.0	334.1	109.0	239.0	33.5	13.9	75.8	47.4	55.2	96.8	749.6	11.5
Average													
1909–13.....	690.1	197.1	351.8	90.5	147.1	20.1	6.5[a]	71.5	37.8	62.0	158.7[a]	758.9[b]	11.5[a]
1922–26.....	807.4	387.7	351.1	134.9	209.4	25.7	9.7	64.1	33.8	62.7	96.0	.....	11.5

Year	Morocco	Algeria	Tunis	Egypt	British Isles	France	Germany	Italy	Belgium	Netherlands	Denmark	Norway	Sweden
1920.....	17.9	16.2	5.2	31.7	56.8	236.9	82.6	141.3	10.3	6.0	7.4	1.00	10.3
1921.....	23.2	28.5	9.0	37.0	73.8	323.5	107.8	194.1	14.5	8.6	11.1	.97	12.3
1922.....	12.9	18.9	3.7	36.6	65.2	243.3	71.9	161.6	10.6	6.2	9.2	.64	9.5
1923.....	20.0	35.8	9.9	40.7	58.4	275.6	106.4	224.8	13.4	6.2	8.9	.59	11.0
1924.....	28.7	17.3	5.2	34.2	53.9	281.2	89.2	170.1	13.0	4.7	5.9	.49	6.8
1925.....	23.9	32.7	11.8	36.2	53.7	330.3	118.2	240.8	14.5	5.6	9.7	.49	13.4
1926.....	16.2	23.6	13.0	37.2	52.2	231.8	95.4	220.6	12.8	5.5	8.8	.59	12.4
1927.....	24.8	27.6	8.3	44.3	55.6[c]	284.4	120.5	195.8	14.4	5.4	9.6	.58	11.3
Average													
1909–13.....	17.0	35.2	6.2	33.7	59.6	325.6	131.3	184.4	15.2	5.0	6.3	.31	8.1
1922–26.....	20.3	25.6	8.7	37.0	56.7	272.5	96.2	203.6	12.9	5.6	8.5	.56	10.6

Year	Spain	Portugal	Switzerland	Austria	Czecho-Slovakia	Poland	Finland	Latvia	Esthonia, Lithuania	Greece	Japan, Chosen	South Africa	New Zealand
1920.....	138.6	10.4	3.6	5.4	26.4	22.7	.27	.39	2.58	11.2	41.1	7.6	6.9
1921.....	145.1	9.3	3.8	6.5	38.7	37.4	.58	.78	3.34	10.3	39.8	8.7	10.6
1922.....	125.5	10.0	2.5	7.4	33.6	42.4	.71	.96	4.17	9.0	39.2	6.3	8.4
1923.....	157.1	13.2	3.8	8.9	36.2	49.7	.69	1.64	3.70	8.8	35.2	6.0	4.2
1924.....	121.8	8.6	3.1	8.5	32.2	32.5	.79	1.58	3.86	8.3	37.3	7.1	5.4
1925.....	162.6	11.5	3.5	10.7	39.3	57.8	.93	2.16	6.08	14.2	40.0	7.8	4.6
1926.....	146.6	8.5	4.0	9.4	34.1	47.1	.92	1.86	5.02	11.2	39.9	9.0	8.0
1927.....	144.8	11.3	4.3	10.4	40.4	54.6	.90	2.65	6.35	13.3	38.3	6.6	9.2
Average													
1909–13.....	130.4	11.8[d]	3.3	12.8	37.9	63.7	.14	1.48	3.63	16.3[d]	32.0	6.0[d]	6.9
1922–26.....	142.7	10.4	3.4	9.0	35.1	45.9	.81	1.64	4.57	10.3	38.3	7.2	6.1

* Data of U.S. Department of Agriculture. For 1909–13, including U.S. Department of Agriculture estimates for area within post-war boundaries. Dots (....) indicate that data are not available.

[a] Four-year average.

[b] Regarded as too low by Soviet officials, whose estimate is 908 million bushels.

[c] Excluding Ireland.

[d] One year only.

TABLE II.—INTERNATIONAL TRADE IN WHEAT AND FLOUR, MONTHLY, JULY–MARCH 1927–28*

(Million bushels)

A.—NET EXPORTS

Month	United States	Canada	India	Australia	Argentina	Roumania	Hungary	Jugo-Slavia	Poland	Algeria	Tunis	Egypt
July	11.6	8.6	5.12[a]	8.1	9.9	.56	1.26	.06	(.42)[b]	(.26)[b]	(.10)[b]	(.47)[b]
Aug.	27.5	14.5	1.57[a]	4.1	5.9	1.34	2.99	.23	(.08)[b]	.51	(.09)[b]	(.51)[b]
Sept.	39.0	17.1	.81[a]	4.2	5.4	1.88	3.28	.16	(.10)[b]	.26	(.18)[b]	(.56)[b]
Oct.	34.7	23.4	.74	2.3	5.3	1.14	2.57	.15	(.45)[b]	(.19)[b]	(.27)[b]	(.60)[b]
Nov.	24.8	57.9	.79[a]	1.6	5.0	1.24	2.26	.22	(.58)[b]	.56	(.02)[b]	(.64)[b]
Dec.	10.2	49.1	.35[a]	2.3	8.7	.95	1.71	.18	(.64)[b]	.16	(.03)[b]	(.52)[b]
Jan.	11.1	18.6	.25[a]	9.3	24.0	.29	1.14	...	(.21)[b]	.34	.00[c]	(.57)[b]
Feb.	5.0	21.8	(.60)[b]	6.4	29.6	....	1.46	...	....	.54	....	(.59)[b]
Mar.	5.8	23.7	....	...	....	....	....	...	....	....	....	....

B.—NET IMPORTS

Month	Irish Free St.	United Kingdom	France	Germany	Belgium	Italy	Netherlands	Scandinavia	Switzerland	Czecho-Slovakia	Baltic States[d]	Japan
July	1.70	17.33	10.00	10.19	3.62	7.59	2.02	2.06	1.43	1.56	.63	1.16[a]
Aug.	1.10	20.78	7.74	6.48	3.50	3.92	2.10	1.86	1.45	2.26	.57	.27[a]
Sept.	1.82	19.59	7.20	6.96	3.67	2.96	2.80	2.35	1.30	1.62	.70	.34[a]
Oct.	1.70	15.18	5.14	9.23	4.12	3.04	3.39	2.18	1.67	1.82	.78	.24
Nov.	2.24	19.13	5.33	8.96	3.60	4.86	3.60	2.45	2.05	1.80	.81	.89[a]
Dec.	1.93	15.74	3.93	8.06	3.62	6.19	2.96	2.89	1.80	2.83	.42	.89[a]
Jan.	1.34	6.78	3.02	7.84	3.02	7.45	2.30	1.77	2.28	1.35	1.16	1.90[a]
Feb.	1.55	14.85	2.80	6.11	2.95	6.98	2.02	1.89	1.59	1.30	.59	1.55

* Data from official sources and International Institute of Agriculture.

[a] Gross, not net. [b] Net import. [c] Net export of 3,300 bushels. [d] Finland, Esthonia, Latvia.

TABLE III.—WEEKLY WHEAT AND FLOUR SHIPMENTS BY AREAS OF ORIGIN AND DESTINATION, DECEMBER–MARCH 1927–28*

(Million bushels)

Week ending	North America	Argentina, Uruguay	Australia	Russia	Danube	India	Other countries	Total	To Europe	To ex-Europe
Dec. 3	14.31	.59	.73	.63	.17	...	1.23	17.66	15.65	2.01
10	10.67	1.35	.26	.23	.07	.03	.81	13.42	10.95	2.47
17	9.29	1.19	.68	...	...	...	1.04	12.20	10.50	1.70
24	8.23	2.50	.80	...	.15	...	.88	12.56	10.21	2.35
31	8.80	1.79	.47	...	.12	...	1.08	12.26	10.72	1.54
Jan. 7	9.39	2.70	1.71	.01	...	...	.88	14.69	11.89	2.80
14	9.62	3.97	1.16	...	...	...	.77	15.52	12.98	2.54
21	9.84	5.88	3.41	...	.02	...	.56	19.71	16.32	3.39
28	8.30	6.41	3.17	...	.06	...	.68	18.62	14.60	4.02
Feb. 4	8.94	6.82	2.61	...	.05	...	.57	18.99	15.09	3.90
11	7.98	9.17	1.69	...	...	...	.50	19.34	15.58	3.76
18	8.26	5.86	2.13	...	.03	...	.56	16.84	13.65	3.19
25	7.45	5.59	1.40	.01	.08	...	.50	15.03	11.63	3.40
Mar. 3	5.24	7.18	1.83	...	.02	...	.62	14.89	11.37	3.52
10	8.10	7.62	2.30	...	.01	...	.37	18.40	14.95	3.45
17	7.06	6.78	.98	...	.04	...	.44	15.30	12.47	2.83
24	7.85	6.92	2.06	...	.01	...	.42	17.26	14.34	2.92
31	7.73	7.04	2.20	...	.02	.02	.46	17.47	13.96	3.51

* Here converted from data in Broomhall's *Corn Trade News*. Broomhall's weekly figures do not always check with his cumulative totals, which presumably include later revisions. Shipments from "other countries" apparently include a part of the shipments from the Danube and Russia in most weeks.

TABLE IV.—WEEKLY WHEAT RECEIPTS AT PRIMARY MARKETS IN THE UNITED STATES AND CANADA, DECEMBER–MARCH 1927–28*

(Million bushels)

Month	United States				Fort William and Port Arthur				Vancouver			
	1924–25	1925–26	1926–27	1927–28	1924–25	1925–26	1926–27	1927–28	1924–25	1925–26	1926–27[a]	1927–28[a]
Dec.	14.18	9.74	5.44	8.90	9.50	14.64	10.55	14.95	1.08	1.94	.95	2.57
	9.23	9.66	5.67	6.41	6.26	14.77	7.14	11.05	1.18	1.30	1.02	2.26
	6.74	8.64	4.91	5.81	2.88	14.56	4.99	9.60	1.18	.74	1.52	2.46
	4.79	6.18	3.98	5.11	2.10	8.82	3.87	8.62	.47	2.15	1.86	3.08
Jan.	4.08	3.45	4.21	4.74	1.39	4.98	4.66	5.91	.74	.60	1.76	2.75
	4.10	6.22	4.69	4.56	1.02	4.32	5.21	5.28	1.12	1.86	1.75	3.16
	5.29	5.23	4.76	4.96	.71	2.73	3.71	6.20	.87	1.99	1.76	3.18
	6.30	4.64	4.64	6.18	.93	1.63	2.81	4.95	.72	2.73	1.11	3.45
	6.32	4.39	5.26	5.96	1.09	1.31	1.98	3.55	.96	2.78	1.76	4.98
Feb.	6.77	4.31	6.16	5.67	.93	1.21	1.98	2.69	.59	2.42	1.33	4.49
	5.08	4.06	4.96	5.67	1.64	1.09	2.27	2.97	.57	1.93	1.35	3.68
	4.28	5.05	5.76	5.02	1.65	.83	2.37	2.52	.61	1.88	.74	3.49
	3.78	3.37	4.33	5.08	1.95	.84	1.97	1.64	.58	1.51	.88	1.88
Mar.	4.71	3.79	4.58	5.87	2.06	.69	1.61	1.31	.32	1.69	1.28	1.88
	4.52	3.01	4.91	6.55	2.10	.71	1.54	.95	.19	1.43	1.32	2.38
	3.86	3.50	4.06	6.22	2.08	.80	1.50	.86	.19	1.27	1.47	2.04
	3.20	3.50	3.59	5.07	1.78	.66	1.25	.50	.27	1.40	1.14	2.28

* United States data are unofficial figures compiled from *Price Current-Grain Reporter;* Fort William and Port Arthur data are official figures for net receipts furnished by Canadian Board of Grain Commissioners; Vancouver data are official figures compiled from *Canadian Grain Statistics.* United States and Fort William and Port Arthur figures begin with weeks ending Dec. 6, 1924, Dec. 5, 1925, Dec. 4, 1926, Dec. 3, 1927; Vancouver figures are for weeks ending one day earlier.

[a] Receipts at Prince Rupert included.

TABLE V.—MONTHLY WHEAT RECEIPTS AT PRIMARY MARKETS IN THE UNITED STATES AND CANADA FROM AUGUST 1924*

(Million bushels)

Month	United States primary markets				Fort William and Port Arthur				Vancouver			
	1924–25	1925–26	1926–27	1927–28	1924–25	1925–26	1926–27	1927–28	1924–25	1925–26	1926–27	1927–28
Aug.	93.0	43.3	71.6	81.6	1.3	1.2	1.5	2.4	.21	.55	.12	.09
Sept.	82.1	57.9	48.7	79.7	7.1	45.7	32.8	8.6	.41	.28	.29	.32
Oct.	88.0	36.1	37.1	73.2	40.9	53.2	56.1	51.4	3.98	7.04	6.37	6.17
Nov.	60.5	34.1	29.8	44.8	42.7	51.5	60.5	71.0	5.05	9.79	7.22	10.78
Aug.–Nov.	323.6	171.4	187.2	279.3	92.0	151.6	150.9	133.4	9.65	17.66	14.00	17.36
Dec.	36.3	34.9	22.4	26.5	20.3	53.5	26.3	41.0	4.21	6.14	6.63	11.81
Jan.	24.7	21.6	24.6	23.5	4.1	10.5	14.0	21.1	3.84	10.03	6.83	16.49
Feb.	19.9	16.2	21.0	22.5	6.2	4.0	8.6	9.5	2.08	7.74	4.27	12.54
Mar.	17.3	15.1	16.6	26.3	8.5	3.2	6.3	3.3	.74	6.98	5.94	10.50
Dec.–Mar.	98.2	87.8	84.6	98.8	39.1	71.2	55.2	74.9	10.87	30.89	23.67	51.34
Apr.	10.4	14.0	14.4	....	8.1	1.8	12.6	....	1.02	3.58	3.58	.....
May	17.6	15.7	19.2	....	7.0	17.2	17.3	....	1.54	1.20	1.56	.....
June	21.9	21.0	20.7	....	4.1	13.6	7.3	....	.74	.22	.61	.....
July	41.8	77.0	58.8	....	6.7	6.4	10.7	....	.11	.27	.14	.....
Apr.–July	91.7	127.7	113.1	....	25.9	39.0	47.9	....	3.41	5.27	5.89	.....
Aug.–July	513.5	386.9	384.9	....	157.0	261.8	254.0	....	23.93	53.82	43.56	.....

* United States data are unofficial figures compiled from *Survey of Current Business;* Canadian data are official figures from *Reports on the Grain Trade of Canada* and *Canadian Grain Statistics.* Vancouver figures include receipts at Prince Rupert after October 1, 1926.

TABLE VI.—WEEKLY VISIBLE SUPPLIES OF WHEAT IN NORTH AMERICA, UNITED KINGDOM PORTS, AND AFLOAT TO EUROPE, DECEMBER–MARCH 1927–28*

(Million bushels)

Date	United States	Canada	U.K. ports	Afloat to Europe	Total	Date	United States	Canada	U.K. ports	Afloat to Europe	Total
Dec. 3	100.0	124.0	9.2	57.1	290.3	Feb. 4	83.7	165.8	6.2	65.5	321.4
10	97.7	140.2	9.6	53.8	301.3	11	82.9	166.0	6.4	72.3	327.6
17	96.9	149.5	9.2	50.1	305.7	18	81.6	166.8	5.6	77.3	331.3
24	96.1	154.7	8.0	45.9	304.7	25	80.2	165.4	5.9	74.8	326.3
31	94.3	159.0	8.0	46.1	307.4	Mar. 3	77.9	163.1	7.0	70.7	318.7
Jan. 7	91.9	159.2	7.7	45.1	303.9	10	76.6	161.3	7.7	68.8	314.4
14	89.5	159.2	7.0	48.7	304.4	17	75.7	158.0	8.2	66.6	308.5
21	86.3	159.0	6.4	55.2	306.9	24	74.7	153.1	8.8	67.4	304.0
28	85.2	166.6	6.1	59.3	317.2	31	73.2	147.4	9.2	68.4	298.2

* United States data are *Bradstreet's;* Canadian data from *Canadian Grain Statistics;* United Kingdom and Afloat data from Broomhall's *Corn Trade News.* Canadian figures are for the days preceding the dates indicated in the above table, and include stocks in some elevators for the preceding week, but are adjusted to bring stocks in western country elevators into the correct week.

TABLE VII.—WORLD VISIBLE WHEAT SUPPLIES, APRIL 1, 1920–28, AND MONTHLY, 1927–28*

(Million bushels)

Date	United States	Canada	Argentina	Australia	United Kingdom	Afloat to Europe	North America	Argentina, Australia	U.K. and afloat	Grand total	Total ex-Australia
1920 Apr. 1	94.9	28.2	6.6	60.0	10.9	59.7	123.1	66.6	70.6	260.3	200.3
1921 Apr. 1	51.7	40.6	3.7	73.0	18.4	58.2	92.3	76.7	76.6	245.6	172.6
1922 Apr. 1	69.4	63.3	4.8	50.0	6.5	65.9	132.7	54.8	72.4	259.9	209.9
1923 Apr. 1	102.1	81.8	9.2	56.5	7.8	52.8	183.9	65.7	60.6	310.2	253.7
1924 Apr. 1	111.3	123.3	10.6	40.0	8.5	65.8	234.6	50.6	74.3	359.5	319.5
1925 Apr. 1	108.8	80.0	11.4	63.0	11.7	84.1	188.8	74.4	95.8	359.0	296.0
1926 Apr. 1	82.0	99.0	6.6	30.5	7.7	46.0	181.0	37.1	53.7	271.8	241.3
1927 Apr. 1	88.7	107.3	14.7	53.0	5.0	75.7	196.0	67.7	80.6	344.3	291.3
1927 Aug. 1	65.9	42.7	5.9	12.7	7.8	46.1	108.6	18.6	53.9	181.1	168.3
Sept. 1	108.7	27.4	4.8	9.7	10.4	44.0	136.1	14.5	54.4	205.0	195.3
Oct. 1	143.7	22.2	4.4	6.8	10.0	50.0	165.9	11.2	60.0	237.1	230.3
Nov. 1	156.0	72.0	3.6	3.0	8.6	56.1	228.0	6.6	64.7	299.3	296.3
Dec. 1	154.7	120.9	3.6	.7	9.6	57.1	275.6	4.3	66.7	346.6	345.9
1928 Jan. 1	143.4	157.8	3.7	41.0	8.0	46.1	301.2	44.7	54.1	400.0	359.0
Feb. 1	128.9	162.8	8.0	51.0	6.4	65.5	291.7	59.0	71.9	422.6	371.6
Mar. 1	118.6	156.5	11.8	43.5	5.8	66.9	275.1	55.3	72.7	403.1	359.6
Apr. 1	110.1	146.6	12.8	36.0	7.7	68.4	256.7	48.8	76.1	381.6	345.6
Average, Apr. 1											
1910–14	84.0	37.6	4.3	14.8	12.4	53.2	121.6	19.1	65.6	206.3	191.5
1923–27	98.6	98.3	10.5	48.6	8.1	64.9	196.9	59.1	73.0	329.0	280.4

* A joint compilation by Broomhall, the *Daily Market Record,* Minneapolis, and the *Daily Trade Bulletin,* Chicago; here summarized from Broomhall's *Corn Trade News* and the *Daily Trade Bulletin.* Includes some flour stocks.

TABLE VIII.—WHEAT STOCKS IN THE UNITED STATES AND CANADA, MARCH 1919–28*

(Thousand bushels)

Year	United States (March 1)				Canada (March 31)				
	Total	On farms	In country mills and elevators	Commercial visible (Bradstreet's)	Total	On farms	In elevators	In transit	In flour mills
1919	362,947	128,703	107,037	127,207	118,543	32,315	69,983	10,855	5,390
1920	351,769	169,904	123,233	58,632	77,306	34,837	30,622	6,272	5,575
1921	336,057	217,037	87,075	31,945	95,477	48,919	35,802	7,120	3,636
1922	256,038	134,253	75,071	46,714	114,986	41,649	58,338	10,999	4,000
1923	313,557	156,087	102,908	54,562	139,788	54,771	69,620	8,397	7,000
1924	308,919	137,721	98,284	72,914	202,493	70,755	111,589	14,149	6,000
1925	256,205	112,095	67,673	76,437	121,084	39,225	68,555	8,304	5,000
1926	224,575	100,137	76,333	48,105	161,376	50,878	95,691	8,307	6,500
1927	277,408	130,230	85,907	61,271	175,978	51,366	103,372	14,740	6,500
1928	284,280	130,007	74,086	80,187	219,546	64,654	130,055	19,037	5,800

* *Bradstreet's* visible, and official data of U.S. Department of Agriculture and Dominion Bureau of Statistics. See especially *Agriculture Yearbooks, Canada Year Books, Price Current-Grain Reporter,* and press releases.

TABLE IX.—CHANGES IN TOTAL FLOUR STOCKS IN THE UNITED STATES (EXPRESSED AS DEVIATIONS FROM A FOUR-YEAR AVERAGE), MONTHLY FROM JULY 1923*

(Thousand barrels)

Crop year	July 1	Aug. 1	Sept. 1	Oct. 1	Nov. 1	Dec. 1	Jan. 1	Feb. 1	Mar. 1	Apr. 1	May 1	June 1
1923–24..	—2,855	—3,285	—1,906	— 519	+1,438	+1,853	+ 697	+ 371	+ 175	— 534	—1,373	—2,180
1924–25..	—3,056	—3,032	—1,710	+ 49	+2,111	+2,308	+1,953	+3,147	+3,467	+1,465	— 492	—2,224
1925–26..	—3,004	—2,834	—2,158	— 438	+1,652	+2,334	+2,392	+2,306	+1,760	+1,193	— 15	—1,576
1926–27..	—2,211	—1,518	— 446	+1,096	+2,301	+2,572	+1,892	+1,063	+ 571	+ 139	— 877	—2,103
1927–28..	—2,797	—3,856	—3,857	—2,941	—2,197	—2,194	—2,849	—3,761	—3,959[a]	.....	.....	.....

* The above estimates for changes in total flour stocks are derived by subtracting estimated consumption from domestic disappearance, and expressing the result in terms of deviations from the four-year average, July 1923–June 1927. For detailed explanation of the method of derivation of these estimates, see WHEAT STUDIES, IV, 74–77.

[a] Preliminary.

TABLE X.—WEEKLY CASH PRICES OF REPRESENTATIVE WHEATS IN LEADING EXPORTING AND IMPORTING MARKETS, NOVEMBER–MARCH 1927–28*

(U. S. dollars per bushel)

Month	United States				Canada		Argentina	Liverpool					
	No. 2 Red Winter (St. Louis)	No. 2 Hard Winter (Kansas City)	No. 1 Dark Northern (Minneapolis)	No. 2 Amber Durum (Minneapolis)	No. 1 Manitoba (Winnipeg)	No. 3 Manitoba (Winnipeg)	Barletta (Buenos Aires)	No. 1 Manitoba	No. 3 Manitoba	Pacific White	No. 2 Winter	Argentine Rosafe	Australian
Nov.	1.43	1.28	1.32	1.21	1.40	1.21	1.38	1.65	1.46	1.45	1.45	1.49	1.55
	1.42	1.30	1.35	1.30	1.42	1.22	1.41	1.71	1.47	1.45	1.46	1.49	1.55
	1.42	1.31	1.33	1.30	1.49	1.26	1.41	1.78	1.48	n.q.	1.51	1.50	1.61
	1.42	1.34	1.34	1.28	1.50	1.28	1.36	1.77	1.51	1.49	1.51	1.52	1.61
Dec.	1.40	1.32	1.34	1.27	1.44	1.25	1.35	n.q.	1.49	1.49	1.51	1.50	1.62
	1.47	1.34	1.37	1.32	1.26	1.25	1.32	n.q.	1.50	1.50	1.52	1.50	1.56
	1.46	1.31	1.37	1.32	1.39	1.23	1.32	n.q.	1.50	1.51	1.49	1.50	1.59
	1.42	1.32	1.38	1.33	1.38	1.22	1.32	n.q.	1.53	1.50	1.51	1.51	1.56
	1.43	1.29	1.38	1.35	1.38	1.22	1.32	n.q.	1.51[a]	1.50	1.51	1.48[a]	1.56
Jan.	1.47	1.36	1.42	1.38	1.41	1.23	1.33	n.q.	1.53	1.50	n.q.	1.51	1.56
	1.49	1.32	1.39	1.32	1.42	1.22	1.32	n.q.	1.52	1.50	1.50	1.49	1.56
	1.53	1.34	1.42	1.29	1.45	1.23	1.32	1.57[b]	1.51	1.50	1.51	1.49	1.56
	1.52	1.32	1.45	1.26	1.44	1.23	1.31	1.58[b]	1.51	1.50	1.51	1.48	1.54
Feb.	1.52	1.31	1.43	1.28	1.41	1.22	1.30	1.57[b]	1.48	1.50	1.50	1.48	1.51
	1.52	1.29	1.40	1.26	1.40	1.22	1.28	n.q.	1.47	1.50	n.q.	1.44	1.50
	1.55	1.33	1.40	1.27	1.42	1.24	....	n.q.	1.47	1.49[b]	n.q.	1.45	1.49[b]
	1.58	1.36	1.45	1.29	1.44	1.26	....	1.61[b]	1.49	1.52[b]	n.q.	1.46	1.52[b]
Mar.	1.61	1.35	1.45	1.33	1.45	1.28	....	1.60[b]	1.51	1.54[b]	n.q.	1.44	1.56[b]
	1.66	1.38	1.48	1.33	1.47	1.29	....	1.63[b]	1.56	n.q.	n.q.	1.46	1.60[b]
	1.68	1.36	1.45	1.31	1.48	1.30	....	1.64[b]	1.56	1.58[b]	n.q.	1.48	1.62[b]
	1.70	1.41	1.47	1.35	1.49	1.32	....	n.q.	1.56	1.61[b]	n.q.	1.51	1.61[b]
	1.76	1.41	1.47	1.35	1.50	1.33	....	n.q.	1.56	1.62[b]	n.q.	1.51	1.61[b]

* United States prices are weekly averages of daily weighted prices for weeks ending Friday, compiled from *Crops and Markets.* Canadian prices are averages for weeks ending Saturday, compiled from *Canadian Grain Statistics.* Liverpool and Argentine prices are Friday prices from *International Crop Report and Agricultural Statistics,* except Rosafé and No. 3 Manitoba at Liverpool which are for Tuesday of the same week and are from Broomhall's *Corn Trade News.* No quotation is signified by "n.q."

[a] Wednesday price. [b] Tuesday price from Broomhall's *Corn Trade News.*

TABLE XI.—MONTHLY PRICES OF DOMESTIC WHEAT IN EUROPE, FROM AUGUST 1925*

(U.S. dollars per bushel)

Month	Great Britain			France (Chartres)			Italy (Milan)			Germany (Berlin)		
	1925–26	1926–27	1927–28	1925–26	1926–27	1927–28	1925–26	1926–27	1927–28	1925–26	1926–27	1927–28
Aug.	1.53	1.76	1.63	1.62	1.61	1.75	1.88	1.85	1.75[a]	1.55	1.75	1.78[b]
Sept.	1.48	1.46	1.43	1.57	1.77	1.57	1.94	2.03	1.73	1.38	1.71	1.68
Oct.	1.34	1.48	1.37	1.48	1.88	1.54	1.94	2.21	1.77	1.37	1.72	1.62
Nov.	1.45	1.62	1.32	1.37	1.96	1.48	1.99	2.20	1.90	1.49	1.78	1.57
Dec.	1.60	1.55	1.29	1.33	1.78	1.58	2.12	2.31	1.88	1.62	1.74	1.53
Jan.	1.60	1.55	1.29	1.39	1.88	1.58	2.17	2.13	1.93	1.61	1.72	1.52
Feb.	1.54	1.54	1.26	1.42	1.81	1.56	2.16	2.11	1.94[c]	1.60	1.72	1.49
Mar.	1.51	1.52	1.27	1.39	1.70	....	2.14	2.11	....	1.66	1.73	....
Apr.	1.57	1.50	....	1.40	1.82	....	2.20	2.02	....	1.87	1.76	....
May	1.75	1.58	....	1.39	1.91	....	2.19	2.16	....	1.92[d]	1.92	....
June	1.77	1.65	....	1.52	1.88	....	2.20	1.99	....	n.q.	1.96[e]	....
July	1.84	1.64	....	1.53	1.81	....	1.98	1.80	....	n.q.	n.q.	....

* Data for Great Britain are averages of weekly average *Gazette* prices as given in the *Economist;* for France, averages of Saturday prices furnished directly by Federal Reserve Board; for Italy, averages of Friday prices of soft wheat as given in *International Crop Report and Agricultural Statistics;* for Germany, monthly average prices as given in *Wirtschaft und Statistik.* All data are converted, for convenience, from the domestic currency in which they are quoted in the above sources into U.S. money by monthly average exchange rates. No quotation is signified by "n.q."

[a] Three-week average. [b] Second half of August. [c] First half of February. [d] First half of May. [e] First half of June.

TABLE XII.—APPROXIMATE DISPOSITION OF WHEAT SUPPLIES IN FOUR LEADING EXPORTING COUNTRIES, 1923–24 TO 1927–28*

(Million bushels)

Item	United States (July–June)					Canada (August–July)				
	1923–24	1924–25	1925–26	1926–27	1927–28	1923–24	1924–25	1925–26	1926–27	1927–28
Initial stocks	151[a]	165[b]	135	111	138	29	41	26	35	48
New crop	797	864	676	831	872	474	262	395	407	440
Total supplies	948	1,029	811	942	1,010	503	303	421	442	488
Net exports	135	258	95	209	205	346	192	324	292	343
Seed requirements	79	84	82	89	96	39	39	40	39	41
Consumed for food	477	479	492	492	502	42	42	42	44	45
Unmerchantable and lost in cleaning	92	73	31	14	65	31	22	18	31	39
Fed on farms						15	5	5	10	10
Apparent error in crop estimate						—11	—23	—43	—22	—45
Stocks at end	165[b]	135	111	138	142	41	26	35	48	55
Total disappearance	948	1,029	811	942	1,010	503	303	421	442	488

Item	Argentina (August–July)					Australia (August–July)				
	1923–24	1924–25	1925–26	1926–27	1927–28	1923–24	1924–25	1925–26	1926–27	1927–28
Initial stocks	56	63	57	67	61	42	38	36	30	41
New crop	248	191	191	221	239	125	165	115	161	109
Total supplies	304	254	248	288	300	167	203	151	191	150
Net exports	172	123	94	143	156	86	124	77	103	65
Seed requirements	21	23	25	24	25	10	11	11	12	12
Consumed for food	45	49	54	55	56	28	29	29	30	30
Feed and waste	3	2	8	5	4	5	3	4	5	5
Stocks at end	63	57	67	61	59	38	36	30	41	38
Total disappearance	304	254	248	288	300	167	203	151	191	150

* Based so far as possible upon official estimates for the various items of supply and disposition. Estimates for 1927–28 are preliminary. For detailed explanation of our method of estimation and adjustment of items in the disposition table, see notes in WHEAT STUDIES, IV, 61 f.

[a] This estimate perhaps too low. See WHEAT STUDIES, February 1928, IV, 169–70, 180.

[b] This estimate perhaps too high. See *loc. cit.*

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OF THE

FOOD RESEARCH INSTITUTE

VOL. IV, NO. 7 JUNE 1928

THE OBJECTIVES OF WHEAT BREEDING

THE objectives of wheat breeding are complex. They ordinarily involve the development of wheat varieties combining high yield with high protein content; but these are difficult to combine, and the breeder must often compromise. The farmer desires the high yields most common in soft winter wheats; but if protein content is too low or quality too poor, he may receive so low a price as to nullify the expected gain from high yield. Since wheat must be adapted to each locality in which it is grown, the breeder must add to his task the development of resistance to fungous and insect pests, to drought, to cold, to hot, dry winds, to a short growing period, and the like. Emphasis on quality in wheat breeding developed only with the advent and growth of world trade in wheat and with the introduction of roller milling in the 1870's. Changes in agricultural technique have also modified the objectives of wheat breeding. For example, lodging was unimportant when wheat was garnered with sickles; but the advent of the harvester and of the "combine" called for development of wheat that would not lodge and would not shatter its seed if allowed to stand in the field after maturity.

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STANFORD UNIVERSITY, CALIFORNIA

June 1928

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OF THE

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STANFORD UNIVERSITY, CALIFORNIA

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The Food Research Institute was established at Stanford University in 1921 jointly by the Carnegie Corporation of New York and the Trustees of Leland Stanford Junior University, for research in the production, distribution, and consumption of food.

THE OBJECTIVES OF WHEAT BREEDING

To increase yield per acre seems so self-evidently the dominant objective of wheat breeding that any detailed discussion of the subject might appear superfluous; yet, in reality, the factors determining the objectives of the wheat breeder are not merely complex, but they change with changing economic conditions and with changes in the economic factors determining farmers' profits. Large yields are desired not for themselves, but because they commonly result in larger profits than small yields. But the most prolific wheat is not necessarily the most profitable, for yield depends perhaps no more upon inherent multiplying power than upon the capacity of the plant to multiply in the special cultural conditions under which it is grown; and this involves the ability to resist disease, adverse climate, and other unfavorable conditions. The objective of the breeder, therefore, often resolves itself into indirect increase of yields through the development of disease-, drought-, and frost-resistant types of wheat.

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Furthermore, the wheat that yields the most in spite of such adverse conditions as it may be called upon to resist is not necessarily the wheat that proves most profitable; for the buyer, commonly the miller, may decline to pay a good price for it because he cannot manufacture from it the type of flour desired by his customers. Thus the gain the farmer expects from increased yield may be nullified more or less by low price. It may pay better to grow some other kind of wheat of superior quality even though it yield somewhat less to the acre. The breeder and the farmer must, therefore, consider not yield alone but quality as well.

High quality in wheat for bread-making purposes is ordinarily associated with high protein content, though quality and protein content are not always parallel characteristics, because the physical properties of the protein are not equally good in all wheats. Superior proteins give to flour the capacity to absorb much water and to yield dough of exactly the proper toughness and resilience to hold the gas generated in the leavening process. If the proteins possess these qualities, the flour can be made into a well-risen, desirable loaf, provided there be enough of the good protein present. If there is not enough, the dough cannot be satisfactorily elastic and it will not absorb much water. If not much water is absorbed, the volume of the dough will be relatively small and the number of loaves per barrel the baker obtains will be few. If the protein is of inferior quality, then the dough is not satisfactorily elastic even though much protein be present; and the loaf will be poor in texture. As a matter of fact, there are varieties of wheat with high content of protein which nevertheless produce flour from which good bread cannot be baked because the proteins have not the proper elastic qualities to make good dough. Therefore, if the breeder is aiming at quality he must produce bread-wheat varieties with much protein of the proper physical character. Flour derived from such wheat is termed "strong"; flour of opposite characteristics, "weak."

It is evident, then, that the objectives of wheat breeding are complex rather than simple. The purpose of this issue of WHEAT STUDIES is to set forth some of the factors entering into the situation, and in particular to emphasize some of the economic aspects. The economic aspects now important are the outgrowth of a long evolution in agriculture, in milling and baking technology, in the science of genetics, and in standards of living. Hence, so far as appears desirable, the objectives of wheat breeding are considered historically; but only such consideration is given to the science of genetics as is indispensable to an understanding of wheat breeding by the layman.

I. BREEDING FOR YIELD OR PROTEIN CONTENT

Local Character of the Wheat Market until Recent Times

Although quality as well as yield determines the farmers' profits, yield is nevertheless in many sections the most important determinant of profits. Farmers very generally want high-yielding wheats. In primitive conditions there were few factors operating to check the tendency to grow the highest-yielding sorts available, for there was little competition from imported wheat in the local market. Transportation was difficult and costly; except to a limited extent, and that only along sea or river routes, there was little trade in so bulky a commodity as wheat; and there were but few communities in which local and imported wheats competed with one another. It had been otherwise in the days of Imperial Rome, which depended largely upon Sicilian and Egyptian grain. In medieval Europe, and even up to recent centuries, the bulk of the grain consumed in most localities was grown locally or near by. Imported wheat rarely influenced the local market, partly because of transportation costs, partly because under the systems of agriculture then prevailing few localities produced surpluses for export. The miller was compelled to rely upon the local product; it was commonly all he could get. If it did not make very good flour and the flour did not bake out into a very good loaf, this was unfortunate but unavoidable, and was not laid to his door. Moreover, as there was no better foreign wheat to furnish a standard for comparison, there was little basis for contrast and complaint. Indeed, in the absence of standards for comparison, miller, baker, and consumer were uncritical. It probably rarely occurred to the miller to criticise the wheat at his disposal or to the consumer that the bread ought to be better. People did as their fathers had done and could not complain since they knew nothing else.

The principal basis for comparison was the variation in quality from year to year. If in one year the harvest was wet and the wheat and flour poor, it was still the only wheat obtainable. It was a misfortune for which no one was to blame; people had to eat the bread, such as it was, or go without. With but few localities where foreign wheat could be brought in in material amount, there could have been little check to the growing of the sorts of wheat giving the greatest yields, even though their quality might be poor as compared with other lower-yielding sorts of better quality equally well adapted for growth in the region. The principal check must have come from the farmers themselves who had their own wheat custom ground for their own use. Thus in India today the sorts of wheat preferred by the native cultivator for his own use are also those Indian wheats most esteemed by European millers. But quality is an elusive trait, while quantity—that is, yield—is plain to every man; and this in itself, even without conscious purpose of the farmer, would tend to favor the planting of the higher-yielding varieties. It is also not at all impossible that in earlier days the public taste was different; and this may be a factor in explaining what appears on present standards as a neglect of quality. Moreover, standards of living were unquestionably lower, and a far smaller fraction of the population was in a position to pay premiums for quality. Indeed, the public had to use the flour from unsound wheat even when it was regarded as unhealthful.

Though flour was made very largely from local wheat, millers in one and the same locality need not have paid the same price for all the local wheat; quite the contrary. Different parcels of the same variety inevitably vary in quality even when grown in the same general area, and were no doubt evaluated accordingly. Some parcels would be less sound than others, if local showers at harvest or bad storage caused damage. Aside from soundness, the chief concern of the miller in those days, and to a large extent today, was the plumpness and large size of the berries. This is well indicated by the weight per measured bushel, the so-called test weight; large, plump-berried wheat has a high weight;[1]

[1] The shape of the berries, determining the closeness with which they pack in the measuring vessel, is also a factor in determining test weight.

small, shrunken, shriveled wheat, a low weight. The millers' interest in the weight per bushel is due to the fact that large-berried, heavy wheat yields more flour per hundredweight than small-berried, light, shrunken wheat. But high crop yields and large size of berry (for the variety) go together. So in these early days, the judgment of the farmer and miller as to what was desirable in wheat did not conflict as much as in later days, when, besides yield, quality of flour for bread baking came more to be considered. There was little necessity to pay heed to flour quality; hence most of the high-yielding wheats developed in the early days of systematic wheat breeding yielded flour of far from superior bread-making quality.

In time agriculture became more and more nearly rational and more and more efficient. Better crop rotations began to be used; deep plowing displaced mere scratching of the surface; heavy manuring was introduced, especially with artificial fertilizers. These practices tend to increase the vigor and duration of growth and also the yield, but the protein content tends to go down. The grains become starchier and more floury (with certain exceptions which need not be considered here), while quality frequently tends to become poorer. At the same time such very favorable cultural conditions insure the survival of all the different strains in a crop. It is only in recent years that the seed sown consists at all frequently of a single pure strain. When the crop consists of several strains or varieties of which one is much more prolific than the rest, its seeds must be present in greater proportion in the harvested crop than those of the less prolific strains, even though in the seed as originally sown the proportions may have been similar. If for succeeding crops seed is sown without selection, it follows that ultimately the crop must consist chiefly of the most prolific strain. It is obvious that, where cultural conditions are so good as not to handicap prolific strains, in the long run yields must go up even when there is no purposeful selection. Since the highest-yielding strains tend to be of poorer quality, quality must go down. There is reason to believe that this actually occurred with improvement in agricultural technique in Western Europe. Indeed, the phenomenon is one of the factors accounting for the so-called deterioration of wheat when seed of high-quality wheat but not of a pure strain from one region is used in another region. Climate and other growing conditions account for a part of the change, but the gradual domination of the more prolific poorer-quality strains accounts for a part of it if, under the changed environment, the prolific strain finds conditions as favorable as the less prolific ones.

Effects of World Trade in Wheat

It is obvious then that in early times there were many factors favoring the culture and the development of high-yielding wheat. When deliberate, purposeful wheat breeding began, the principal objective was naturally the development of high-yielding sorts. Wheat breeders began seriously to breed for quality as well as yield only long after a general world trade in wheat had been established. They were no doubt stimulated thereto by the premiums paid for certain types of high-quality wheat which formed an important fraction of that trade.

The world trade in wheat was the direct result of the growing industrialization of civilization. Science and invention industrialized the world, increasing the number of mouths to be fed, and at the same time furnishing through cheap transportation a world market for the surplus of goods produced by industrialized countries. The sale of this surplus furnished the means for the purchase of the extra food needed, and cheap transportation made such purchase feasible. At the same time a surplus of wheat for exchange against manufactured goods became available through the opening of new lands in America and elsewhere. Much of this was grassland which, through science and invention, could be brought for the first time under the plow. Besides the steamboat and the railroad, the inventions involved were well-digging and agricultural machinery; for much of the grassland of the world is semi-arid, and its per-acre yields are usually comparatively low. If, then, the farmer is to exist, and also produce the surplus which he requires to exchange against necessities not producible upon grasslands, he must cultivate an acreage larger than is possible without the use of agricultural ma-

chinery and the aid of considerable power, whether supplied by animals or machines. With the inauguration of the world trade in foodstuffs, the economic isolation of the Western European wheat farmer was gone. Except in so far as he was sheltered behind tariff walls he had to face the competition of the world. In England the tariff walls, the corn laws, were radically reduced in 1846 (effective in 1849), and all duties were abolished twenty years later; for a generation after 1865, trade was less hampered by tariffs in Europe than at any time before or since.

The earliest competition came probably from Hungary and the Balkan countries. The river systems of Central Europe furnished cheap transportation. The United States was also an early exporter. Soon southern Russia became a factor and was followed by India, Australia, Argentina, and finally Canada, as sea freight rates went down, and railroad mileage increased, and as Australia, Argentina, and Canada came to be more populated.

Much land has a climate wherein only varieties with a short growing period can be grown. Such wheat tends to be hard, flinty, vitreous,[1] and high in protein content —a type of wheat new to millers when it first came to Western Europe. They did not know how to handle it. Their machines, millstones, were not well adapted to producing flour from it. In consequence it was not fully appreciated, and lower prices were paid for it than for the better classes of local wheats. This state of affairs did not at first affect the United States seriously. Wheat was not yet produced on the semi-arid Great Plains, which were not yet settled sufficiently to produce a surplus. The wheat exported came from nearer the Atlantic seaboard. In the first third of the nineteenth century Virginia was a great wheat state and in the middle half of the century Rochester, New York, was the greatest milling center. Hence, in those days the bulk of the wheat exported from the United States was soft winter wheat.[2]

The objectives of the wheat breeders were still to produce finer types of high-yielding wheat that would mill out the maximum of flour. Relatively little attention had to be paid to breeding high-protein wheats since they did not command better prices. The development of better spring wheats came later in drier and colder portions of the country when these came to be settled. As wheat acreage expanded in these regions, the effort of wheat breeders was in the direction of increasing the winter hardiness of winter wheats, and where this failed to insure a crop, to resort to spring wheats. The desire for winter wheats where possible is due not solely to the fact that they incline to be heavy yielders but also to the fact that the growing of winter wheat brings with it a better distribution of farm labor through the year. On the other hand, the spring-wheat grower has the advantage that in the spring the probable price of the crop can be somewhat more accurately fore-

[1] The vitreous appearance of some wheats is apparently merely a physical property. In such wheats the starch granules are closely imbedded in the matrix surrounding them, whereas in the non-vitreous types the granules are less closely imbedded so that fissures or air spaces separate them to a greater or lesser degree from the surrounding matrix. From the surface of these tiny internal cavities light is reflected, giving the grain an opaque or whiter appearance. Vitreous wheat may be made opaque by merely soaking in water and then drying. This treatment, as may be demonstrated with the microscope, causes internal air spaces to develop. Since opaque wheat contains more air spaces than vitreous wheat, it is less dense, i.e., has a lesser specific gravity. This is of commercial importance, since the average density of the berries is one of the factors determining the weight of a measured bushel, i.e., the test weight.

[2] The term "winter wheat" is applied to the varieties of wheat which are customarily planted in the fall and harvested the following summer. If planted in the spring, most of them grow during the ensuing summer but do not head and produce seed until the summer of the following year. They commonly exhibit a creeping habit of growth, covering an appreciable surface of ground by the process known as stooling or tillering. By tillering is meant the habit which wheat shares with many other grasses of dropping some of its branches to the ground and so growing roots at the nodes on the branches. Because of this habit of growth, they produce more stalks and ears per plant than spring wheats. These have a shorter growing period than the winter wheats, being customarily sown in the spring and harvested in the late summer; they tiller less; and they produce fewer ears per plant. In some climates, California for example, spring wheats are sown in the fall and harvested in the early summer. Therefore, to speak of the two sorts as winter and spring wheat is not strictly accurate. It would be better, at least in scientific work, to speak of them as wheat with winter and wheat with spring habits of growth, respectively. Common winter wheat and common spring wheat are varieties of the same species, *T. vulgare* Vill. Indeed, between the two habits of growth as well as in length of growing period all intermediate gradations may be found. Club wheat, *T. compactum* Host., may be of either winter or spring habit. Durum wheat, *T. durum* Desf., is usually of spring habit.

seen than six months earlier and consequently the area under wheat can be increased if conditions appear to justify it.

Introduction of Hard Wheats

In breeding spring wheats the effort was at first not in the direction of producing hard, high-quality varieties, but rather to produce drought- and rust-resisting forms of early maturity, in order to avoid frost damage in the fall. That varieties with these characteristics were usually hard, high-protein sorts was rather a misfortune at first, for these wheats were not highly prized by millers. Farmers everywhere would have preferred high-yielding soft winter wheats. These were displaced by lower-yielding hard spring wheats only where climatic conditions made the growing of soft winter wheats too hazardous or impossible.

This state of affairs continued until the introduction of the roller process of milling. It is perhaps not an accident that the process was invented in Hungary, which produces fairly hard wheat. The process began to be widely employed in the United States in the late 1870's. Thereafter hard wheats came to be appreciated because, if properly milled, they produced whiter flour of superior quality from which better bread might be baked. Hard wheats, instead of being discounted by millers, began to carry premiums over many sorts of winter wheats. The introduction of the process of roller milling proved an important factor in changing the wheat map of the world.

As harder wheats came to be sought, wheat breeders began to pay increasing attention not merely to the production of high-yielding varieties but also to the production of hard, flinty, vitreous, high-quality sorts both of winter and of spring habit of growth. In the United States and Canada the first steps were in the direction of the introduction of high-quality wheats from other regions with similar climates. Useful sorts were introduced from southern Russia, from the Mediterranean littoral, from India, and elsewhere. These were the foundation stocks with which breeders operated. In the beginning the efforts were to produce types with very hard, dark, vitreous berries. Little attention was paid to protein content because the chemical analysis of wheat for the determination of protein content was difficult. It was not till 1883 that the Danish chemist, Kjeldahl, made public a relatively simple method for the quantitative estimation of nitrogen; from nitrogen content protein content may be calculated.

This method made it possible for the plant breeder to substitute an exact quantitative measure for the rough subjective estimates based on hardness, color, and translucency. However, few breeders took advantage of the chemical method, perhaps because the protein in a small sample or in a single kernel could not be estimated by the method in its original form. To use the method the breeder had to have at his disposal an appreciable amount of seed. In selecting a plant for propagation he very naturally hesitated to sacrifice most of the seed in order to learn more accurately than was possible by inspection how much protein was in the seed. Thus Saunders in developing Preston and Marquis wheats used the chewing test. The kernel is chewed slowly till most of the starch is removed, leaving most of the protein, which is known as gluten, behind between the teeth. From its feel in the mouth an experienced person may gain a fair idea of the amount of protein in the wheat and of its physical properties.

Within the last few years the Kjeldahl method of estimating nitrogen has been much improved by the development of the so-called micro-method, which requires only a minute amount of material. With its help the amount of nitrogen in a single seed and indeed even in only a part of a seed can be determined accurately. Thus it should be entirely feasible to dissect an individual seed into its principal organs—the seed coat or bran, the main part of the berry; the endosperm, which yields the flour; and the embryo—and to estimate nitrogen separately in each. This should be helpful in estimating the probable protein content of the flour, for this is always less than that of the berry because, in milling, the bran and embryo, which contain more protein than the endosperm, are eliminated. It should also give some help in judging probable flour yields, for these depend not merely upon test weight, but also upon

thickness of bran coat and size of embryo.[1] Though the micro-method should be an invaluable help to breeders, it does not as yet seem to have been used by them.

Changes in the Milling and Baking Industry in Recent Times

One of the most potent factors in forcing upon the breeder the development of high-protein rather than of merely high-yielding wheats has been the change which for more than a generation has been taking place in the milling and baking industries. Milling was a small local business before the days of cheap freight rates. Just as in most of Europe the wheat of the farmers of one locality did not much compete with the wheat of farmers in another locality, so the flour produced by the millers of a given locality did not much compete with that produced in another locality. It was a local gristing business, custom milling. Moreover, the millers in a given locality all had the same wheat, the same raw material to work upon. The difference in the flour of two locally competing millers was due primarily to differences in their respective skill. As the international trade in wheat and flour developed and as millers began to have a choice of raw materials, they were enabled to control the quality of flour by selection of the sorts of wheat purchased for milling. The art of blending wheats for milling developed. Thus competition between wheats was established and the judgment of the individual miller in the purchase of his raw material and in blending different sorts of wheat became as potent a factor in his success as skill in the mere mechanical operations of milling.

Naturally, these developments were first most pronounced in Europe, since to Europe began to flow all kinds of wheat from the corners of the globe, and in particular high-quality wheats from North America. Naturally, the mills situated at the seaboard were first affected; the practice of using imported wheat spread only gradually into the interior of Europe. Indeed, in many countries milling tended to be concentrated at seaports; even today in the several countries of Europe it is still so concentrated. At present great milling centers are located either close to, if not actually in, a region where high-quality wheat is produced, or at some point toward which transportation routes from many wheat-producing sections converge. In the United States such milling centers as Minneapolis–St. Paul and Kansas City exist because they are close to regions producing excellent wheat. Budapest in Hungary owes its pre-eminence in milling to the same cause.

The concentration of milling in these favored localities made possible larger and more efficient units, a movement that was favored by the introduction of the roller process which required more investment in machinery. However, the most important factor causing the establishment of large mills and the gradual disappearance in many countries of the small local mill was increasing concentration of population in large cities. The net result was that wheat was milled where the miller could buy it most advantageously and ship flour to the consuming centers, having due consideration for the costs of transportation inward and outward and the markets for mill by-product, millfeed. In Europe these centers are commonly at seaports except in a few countries which import only a minor fraction of their wheat and flour requirements. In the United States and Canada, which export both wheat and flour, milling centers, as above stated, are developed near wheat-producing regions or at points of convergence of transportation routes.

In buying wheat, the large mill, the existence of which is the consequence of the world wheat trade, finds it of the utmost importance to pay especial attention to quality. At first, and indeed until recently, wheat was bought on the judgment of the buyer. Many of the wheat buyers acquired an uncanny skill in foretelling from appearance and physical properties, such as weight per bushel, color, soundness, hardness, vitreousness, et cetera, the quality of flour that could be produced from a given parcel of wheat. On this basis the grain trade of the United States gradually evolved a series of grades which were a general, though far from precise, expression of wheat qualities. These grades were crystallized into the

[1] Clark, Martin, and Ball have found that the size of the embryo is a very constant varietal character. *Classification of American Wheat Varieties* (U.S. Department of Agriculture Bulletin 1074), November 8, 1922.

United States official grain standards in 1916, but the range between any two of these grades is still wide enough to leave ample play for the judgment of the individual wheat buyer. The grades are not based primarily on chemical analysis. They did, however, in their day help higher quality in wheat to receive recognition.[1]

Just as the gradual concentration of milling in larger factories resulted in greater emphasis upon quality in wheat, so the more recent concentration of baking in larger plants is exerting an analogous effect. In America bread baking is leaving the home kitchen more and more and passing into the bakery. While in the United States this transition is far from complete, in many countries of Europe home baking practically disappeared years ago. Nevertheless, in these countries, as well as in the United States, bakeries until a few decades ago were small units using but little machinery and furnishing a relatively small output per plant. This has been changing. Large bakeries in most countries are growing more numerous; in recent years they are using more and more machinery. While under any conditions that one can foresee for the more immediate future there is no prospect that a bakery will be able to supply as wide a territory as a mill, because bread is so much more perishable than flour, nevertheless bread baking is being more and more concentrated in fair-sized plants.[2] In consequence greater care is being devoted to the purchase of flour. Indeed, the larger bakeries find it advantageous to employ chemists to buy flour, as well as other supplies, on chemical analysis and on specification. There were few bakeries a generation ago large enough to warrant employment of chemists; indeed this is still true of a very large proportion of them. The baking chemist introduced the purchase of flour on specifications in which protein content plays an important rôle. This does not mean that the larger bakeries are more dependent on high-quality flour than heretofore; quite the contrary. The housewife must have a high-grade, foolproof flour; but the efficient baker can get results with less good kinds. Indeed, bakers tend to use less patent flour than formerly, but they tend to buy it upon chemical specifications that include protein content, though a high protein content is not invariably demanded.

One reason for the baker's eagerness to purchase high-protein flour is high bread yield, which is vital to him since it is an important factor in determining his profits. Flour with much protein of high quality absorbs much water in being doughed and yields more loaves to the barrel of flour. This is therefore the type of flour most desired by the baker. It is one of the reasons why he specifies a minimum protein content of flour and why he is often willing to pay a premium for it.

So keen is the skilful baker to incorporate as much water as he can into the loaf without reducing its acceptability to the consumer that he resorts to a number of devices to achieve that end. Only one of these, the mechanical high-speed mixer, is of interest here. This is a machine for kneading the dough mechanically. Introduced as a labor-saving device to imitate hand-kneading, it was soon found that the machine incorporated water more thoroughly than the journeyman baker, and so increased bread yields. When the machines are run at relatively high speeds, the absorption of water into the dough can be increased sufficiently to pay. Hence, hand-kneading is gradually disappearing. The change is vastly facilitated by the general availability of small electric motors. Everyone knows that mechanically working an elastic material ultimately injures its elastic properties. Obviously, the new mechanical method of kneading is a severer strain upon the elastic properties of dough than hand-kneading. Under the new method flour proteins in the dough must be able to stand more "punishment" than before. Varieties of wheat satisfactory for hand-kneading may prove less so when kneaded by machine. Blackhull wheat, a new Kansas variety of high-protein winter wheat, is said to behave in this way. It is reported as making satisfactory bread if kneaded in the ordinary way, but bread not quite so good if worked in a high-speed mixer. It seems likely that the mechanization of bakeries

[1] Cf. "Protein Content: A Neglected Factor in Wheat Grades," WHEAT STUDIES, February 1926, II, 164–76.

[2] C. L. Alsberg, *Combination in the American Bread-Baking Industry, with Some Observations on the Mergers of 1924–25* (Miscellaneous Publications of the Food Research Institute, No. 3), February 1926.

has introduced new problems for the wheat breeder to solve.

Flours with the maximum of good-quality protein are desired by the baker for several other reasons besides the high bread yields he is able to obtain with them. One of these is that it is less difficult to produce acceptable bread from good high-protein flour than from good low-protein flour. Strong flours require long fermentation periods because the rate of maturation of the dough is slow. Hence, the baker has considerable latitude; a little longer or a little shorter fermentation time does not spoil the bread. If there is a breakdown of machinery while the dough is fermenting, he has some leeway to make repairs. Weak flours, on the contrary, mature very rapidly and should be fermented only a relatively short time. The dough must be molded into loaves and placed in the oven at exactly the right stage. The baker, if any delay occurs, has little leeway and runs greater risk of uneven quality of his product.

There is still another reason why in America the baker is so eager for high-protein flour; it produces the type of loaf preferred by the American public. This is a large, very white, puffed-up loaf, baked in pans rather than on the oven's hearth. High-protein flours lend themselves better to the production of this type of bread than flours poor in protein. The taste for this type of bread is largely connected with the fact that in America bread is being used more and more as a vehicle for spreads. A puffed-up loaf naturally serves this purpose better than a more compact loaf of the same weight. Moreover, size rather than weight is an important factor in the sale of bread in America. The consumer feels that the larger loaf contains more bread even though its weight be less than that of a less puffed-up, competing loaf. Even where there are legal standards for weight of loaves, this is a factor which bakers do not ignore. It favors the production of the puffed-up loaf and the use of high-protein flours. In Europe the type of loaf preferred is different, and the bakers' demand for the very high-protein flour is apparently less insistent. Millers there rarely produce flours from the hardest wheats alone. Nearly always the bread flours preferred seem to consist of blends of hard with softer wheat. It is stated that with such blends the European baker secures more nearly the desired bread of the European consumer than is possible with flour from a single kind of wheat. Australian wheat, for example, is said to give the loaf a particularly fine bloom. Other sorts of wheat are used in the blends for flavor which in Europe seems more important than in America, perhaps because in Europe bread is for the most part made from flour, salt, and yeast alone, whereas in America, in addition to these, other ingredients, sugar, shortening, and milk, are generally used. Naturally, in bread containing a number of ingredients the flavor of any single one is less important. There are, nevertheless, indications that the European baker is becoming aware of the desirability of buying flour on chemical and other specifications, and it is to be anticipated that the trade there is not unlikely to follow the practices in buying becoming current in the United States.

It is a characteristic of the American consumer's demand that he desires a white loaf without tinge of gray or of yellow. Some good sorts of wheat yield flour of a creamy tint and this makes them less desirable. The objection to such kinds of wheat is less nowadays than it used to be because of the general practice in America of bleaching flour. In Europe, where bleaching is not so widely practiced, inherent flour color is more important, even though it would seem that the European consumer is less exacting in his demands for a very white loaf than the American. Consequently European millers in blending wheat must pay especial attention to color.[1] No doubt the greater skill now being exercised both in Europe and in America by the great bread-baking companies has been an important factor in changing the objectives of wheat breeding or at any rate in making them more precise.

[1] The color of flour is not due to the color of the wheat from which it is milled. In red wheat the pigment resides in the seed coats, which are removed in making flour. White wheat is devoid of this pigment. The flour from both sorts is white. Flours with a creamy color owe this trait to the presence of a yellow carotinoid pigment in the endosperm. It is present in all or nearly all wheats, but in varying amounts. The whitening of flour in ageing is due to the gradual fading of this pigment. When flour has a grayish tint or contains specks this is due to the imperfect removal of the bran. The bran left in flour from red wheat is of course more conspicuous than that from white wheat. The gray color of inferior clear and low-grade flour is due to the presence of appreciable amounts of finely divided bran.

Premiums for High Protein Content in Wheat

The effect upon the miller has been profound, for he is now often required to furnish flour with the specified minimum of protein. He in turn has been compelled to modify his methods of buying and evaluating, adding to his basis of judging wheat its protein content. He, too, is compelled to employ chemists for the purpose. In milling flour he is required to blend wheats in such proportion that the resulting flour has, as exactly as may be, the specified protein content. If it has less, the flour is likely to be rejected; if it has more, the miller's costs will be more than they need to be and his profits less, since as a rule high-protein wheats are more expensive than low. The effects upon prices paid for wheat have been profound. Very large premiums are paid for high-protein wheats in seasons when these are scarce; premiums of sixty cents a bushel and more above the base for the grade are not unknown. Such wheat is blended with less expensive, lower-protein wheat to produce a flour meeting the bakery chemist's specification.[1]

Naturally, this growing practice on the part of the baker has its effect upon the wheat farmer. It creates more favorable economic conditions for the farmer so situated that he can grow only short-growing-period wheats—since these are commonly high-protein wheats. The premium paid for these wheats serves to some extent to counterbalance the low yields. To be sure, ever since these hard wheats began to be appreciated, more was usually paid for them than for most soft wheats.[2] The grading of the grain exchanges and the federal grain standards were adjusted to give them recognition in a general way; but present methods of evaluating flour have served to increase appreciation for them and to cause the adoption of what amounts to a sliding scale of prices based on protein content for a given grade, other things being equal. The result has been to stimulate the farmer more than ever to produce high-protein wheat and this in turn is now stimulating the wheat breeder to attempt to produce improved and higher yielding high-protein varieties for the regions naturally endowed with a climate capable of producing high-protein wheat.

Even in regions where only soft winter wheats thrive, it is realized that there is no necessity to plant sorts with the very lowest protein content. For such localities it is possible to find or produce varieties which contain a fair measure of protein, even if the high figures of the best hard wheats cannot be attained. With such wheats it will be necessary to blend only relatively small quantities of wheat of distinctly high protein content in order to produce good flour.

Thus over much of the globe today an important objective of the wheat breeder is to give the farmer wheats with higher protein content than at present. The object is to do so without unduly sacrificing yields; to produce a wheat that will fetch a better price, yet not to sacrifice so much in yield as to absorb the increment in price. This, for example, is a principal objective in England at the present time and has already resulted in the production of the Yeoman variety, which is fairly high in protein and yields about as much as other varieties generally grown in England.

In some sections of the United States lower yields of high-protein wheat give a better net profit than larger yields of softer wheat, but for the most part this does not seem general; and naturally, in many sections farmers do not grow the lower-yielding sorts. Moreover, the protein premium paid in the terminal market upon the individual parcel of grain is not everywhere and at all times fully reflected back to the farmer who grew it, partly because the official grades take no direct cognizance of protein content, partly because there is no

[1] With full appreciation of the commercial value of protein, there are indications that the protein premiums are being overdone. Not unnaturally, the pendulum of chemical analysis has swung too far. We doubt whether the very high premiums paid for protein during the past season could be justified by many of the mills paying them. One-tenth of one per cent of protein lies within the error of the total process of sampling and analysis, yet it has figured in many commercial transactions during recent months.

[2] In the United States, however, in seasons of short crop or poor quality of soft red winter wheat, high-grade wheat of this kind commands a premium. In Europe, imported hard wheats usually sell at higher prices than domestic soft wheats, even where tariffs are inoperative. But for special reasons Australian wheat ordinarily commands as high prices as any but the superior grades of hard wheat, like No. 1 Northern Manitoba.

good, simple system of estimating protein content at country shipping points.[1]

While injustice may be done to the individual grower, the general effect upon wheat growing is less than might be supposed, because the official grades divide wheat into classes corresponding roughly to the amount and quality of protein they usually possess. Moreover, in the markets the place of origin of the different parcels is important. Buyers know the general quality of the different sorts of wheat and they also know in a general way the most probable protein content of the wheat from a given territory. This knowledge results in the adjustment of the general price level of a particular sort of wheat from a particular region in accordance with the esteem in which the variety is held, the general character of the wheat originating in the territory in question, and the demand and supply relations of the moment for that type and quality of wheat. Thus the general price level of the wheat of a given region may be high even though some farmers whose wheat is above the average of the region fail to receive the protein premium to which they are really entitled. Hence the discouragement to growing the highest-protein wheat possible is not as serious in all sections as one might suppose, though it is a real factor.

Moreover, variations in protein content of individual parcels of the same variety of wheat from the same region are accidental and rarely due to the deliberate act of the grower. They are, within the variety, the result of differences of climate, soil, season, and the like, and commonly not within the control of the farmer—at least in the United States. Furthermore, being largely due to the weather, the individual farmer who one year has wheat above the average quality, is just as likely as not to have wheat below the average the next season. Nevertheless, there can be no question that if it were possible to reflect back the premium to each individual grower this would not merely be ordinary justice but would also be economically most helpful to those sections which can grow only high-quality, low-yielding types of wheat.

While protein is at the moment perhaps the objective most in the public eye, the reader should not get the impression that it is the only objective. Yield will probably always remain the most important. The breeder of today is endeavoring to develop wheats combining high yields with high quality; to the breeder of the middle nineteenth century yield was the important objective and quality as understood today quite secondary. Quality meant for the most part large, plump, free-milling traits. Today there are other factors also that are important.

II. BREEDING FOR PLANT CHARACTERISTICS

Problems Raised by the Mechanization of Agriculture

The mechanization of agriculture has also modified the objectives of the wheat breeder. When wheat was grown in small tracts and labor was relatively abundant, harvesting was done by hand with a sickle. The harvest was adjusted exactly to the most favorable stage of maturity and almost every stalk was garnered individually. The stalks were carefully bound into sheaves, so that losses during harvesting were reduced to a minimum. As the area in wheat relative to available labor became greater and as labor-saving machinery began to be introduced, the harvesting operation became larger scale and less careful. First came the scythe, and then the cradle. These were followed by the reaper and binder and still later by the combined harvester-thresher, which cuts and threshes in one operation. Each successive one of these inventions handles the wheat less carefully and more roughly than its predecessor. The losses from shattering are therefore greater with each successive improvement in harvesting machinery. With the increasing mechanization of agriculture, therefore, it became necessary for the breeder to add to his objectives the development of non-shattering qualities in wheat.

It was, of course, always the object of

[1] See, however, the promising method recently proposed by Shollenberger and Kyle for hard spring wheat. "Correlation of Kernel Texture, Test Weight per Bushel, and Protein Content of Hard Red Spring Wheat," *Journal of Agricultural Research*, December 15, 1927, XXXV, 1137–51.

wheat breeders to produce varieties with straw that would not easily be beaten down in the field by rain or wind and would not lodge when conditions were favorable for rank growth. However, while wheat was garnered with a sickle, the tendency to lodge was not as serious a defect in wheat as it later became with the introduction of harvesting machinery. As such machinery became larger, heavier, more completely automatic, ability to stand upright quite as much as non-shattering qualities became of great importance, and more and more attention had to be devoted to this wheat character.

The introduction of harvesting machinery emphasized the importance of stiffness of straw and non-shattering qualities also because it made difficulties for the individual farmer in harvesting his fields at exactly the ideal moment of maturity, before much shattering or lodging had time to occur. While wheat was cut by hand or by horse-driven machines, shocked by hand, and then threshed from the shock at some convenient time, each farmer could own the necessary machines (except threshers) and harvest at or near the ideal time so long as his field was small. Where the combined harvester has come into use, the capital investment has become so large few farmers can afford to own a harvester if it is to be used only in their own fields. Most farmers find it advantageous to have harvesting done for them. However, a given farming community warrants the maintenance of only a limited number of machines; individual farmers must wait their turn so that it is often necessary to leave the wheat standing in the fields for days after the grain is fully ripe. Hence stiff straw and non-shattering characteristics are important properties where a dry harvesting season makes it feasible to leave the wheat in the fields for several days uncut. These properties are especially important where there are high winds to buffet the grain about. Conditions of this sort prevail in many sections of the Pacific Coast states and are responsible in part for the continued growth there of club wheats which do not lodge or shatter in marked degree, though they are rather poor for bread-making purposes. In Canada, on the other hand, the large machines enable the farmer to allow the field to dry before cutting, in conditions that would necessitate cutting the field wet with a small self-binder.

The standing capacity of the straw is, moreover, in some European countries a limiting factor on output because farmers do not dare to fertilize beyond a certain degree for fear that the resulting rank growth will cause enough lodging to nullify the increased formation of seed. Danger of lodging may be obviated either by breeding varieties so stiff they will stand in gales or with straw so pliable they will by bending relieve the strain on the roots. Ability to withstand lodging is not merely a matter of straw characteristic but also of how effectively the plant is buttressed with roots, the so-called adventitious roots. It is plain, then, that lodging may be lessened in a number of ways: either by stiffening the straw or making it more pliable, by increasing the number and strength of the adventitious roots, by shortening the straw and so lessening the leverage of the wind. These ends can be attained by breeding special varieties or by modifying cultural conditions. A rank-growing variety, for example, may produce the right length of straw where rainfall is scanty but will lodge where there is heavier precipitation.

What matters to the farmer is quantity and character of grain, rather than the nature of the plant that produces the grain. The plant is the means to an end; its characters are important only in so far as they are conditions for seed production and especially for high yields, so long as high yields mean high profits. High yields may be attained either by increasing the hereditary capacity of the plant to produce seed, or by adapting the plant to overcome local conditions of climate, soil, planting, cultivation, or harvesting that prevent the inherent capacity of the variety to produce seed from becoming manifest. If a hardier variety developed by the breeder is grown and the farmer does not suffer loss by winter-killing, early frost, or too low temperatures at unfavorable times, obviously his yield is greater than it would otherwise have been. He finds it advantageous to grow the hardier wheat since production is less hazardous, even though the hardy variety possesses less inherent capacity to produce high yields than some other variety.

Hardiness in Wheat

Hardiness in winter wheat is a somewhat different character from hardiness in spring wheat. In the former it is principally ability to resist severe winter weather and in particular repeated and alternate freezing and thawing. In spring wheat it means, rather, ability to make satisfactory growth even if the weather is not hot, and above all to resist early frosts. Hardiness of winter wheat, therefore, can be developed only by increasing the inherent resistance of the plant; whereas the danger to spring wheat from early autumn frosts may be met in this way or by developing early-maturing sorts. It seems that varieties showing greater resistance to cold have firmer tissues, a higher dry-matter content, and a more concentrated sap, i.e., a sap with more material dissolved in it. They hold on to the water they contain more tenaciously than less cold-resistant varieties. The discovery of these traits of hardy plants is of practical importance since it should enable the breeder to test the hardiness of individual plants without being compelled to wait until he is fortunate enough to have severe weather come at just the right time. In many sections winters of the peculiar type of severity that tests the hardiness of winter wheat come at quite irregular and unpredictable intervals. This is of course also true of premature autumn frosts.

Analogous to frost resistance is the ability to germinate at low temperatures. It is obvious that this too is an important objective of the breeder, for a variety that is able to germinate at low temperatures may be planted later in the fall or earlier in the spring, as the case may be. Under some circumstances this may be of great advantage not merely as it affects distribution of farm labor, but also because it may be helpful in giving the young wheat plant a good start. Moreover, if the seed bed is too dry at the time of sowing winter wheat but rain falls later when the weather is cold, it is obvious that ability to germinate in spite of low temperature is of the utmost importance. The first few weeks of the life of the wheat plant are critical. Recent experiments seem to indicate that the extent to which the seedling exhausts the endosperm determines the size of the first leaf.[1] But the size of the first leaf determines the size of the second leaf, and the first and second leaves together, the size of the third, and so on, till in the end the size of the first leaf determines the size of the plant itself, at least for spring wheat. It is obvious, then, why the period from germination to the full development of the first leaf is so critical for the plant. Indeed, too little attention seems to have been paid by wheat breeders to the requirements of the wheat plant in the first few days during and after germination. Adaptation to the temperature and moisture conditions then prevailing is vital. Early tillering is also important so that the plant may cover the ground as early as possible and thus fight weeds more successfully.

If earliness with hardiness and high-yielding capacity can be combined in one strain for cultivation on lands located far north or at high altitudes, the wheat acreage of the world may be substantially increased. Earliness, however, is usually conceded to be attained at the sacrifice of yield; a larger world acreage can be put into wheat, but per-acre yields are not increased except in far northern or high-altitude lands. Drought resistance is analogous to earliness. The development by the breeder of more drought-resistant forms makes possible an increase in wheat acreage; but it tends to increase yields only in semi-arid regions. Analogous to drought resistance is ability to germinate with a minimum of moisture. In view of what has already been said concerning the first developmental stage of the wheat plant as a critical period, the importance of this objective of wheat breeding is obvious in regions where the seed bed may be too dry for ordinary varieties. This is especially true in many sections of India. The introduction of early-maturing and drought-resisting forms has been an important factor in permitting the spread of wheat culture in the western portion of the Great Plains and intermountain country of the United States and much of Canada. Indeed, the Canadians have taken the lead in developing early-maturing varieties, such as Ruby, Garnet, and Prelude.

Earliness is useful and affects yields favorably, not merely in regions where early frost or drought are to be feared, but also in humid regions where yields are reduced

[1] Observation of H. L. van de Sande Bakhuyzen at the Food Research Institute, as yet unpublished.

by stem and leaf rust, smut, bunt, mildew, or insect attack. Earliness in maturity in a disease-susceptible strain may counteract the defect by allowing the wheat to be harvested before a serious infection occurs. Yields may thus be increased even though the early variety in question may not be unusually prolific under ideal conditions. Reduction in yield from disease may be counteracted in another way, by the development of varieties that are by nature resistant to the particular form of disease that does the damage. More attention than formerly has been paid in recent years to the development of disease-resistant forms, especially in America and in the newer wheat-growing countries. The reason is perhaps to be found in the fact that in America disease is a more important factor than in Europe. This is because wheat is planted in vast, continuous areas, which favors the spread of disease, whereas in Western Europe the areas are smaller, discontinuous, and cut up into separate sections by ridges and mountain ranges, which offer more or less impediment to the spread of parasitic infection. The development of resistant strains has been facilitated by study of the parasites. Gradually the life history of the parasitic fungi is becoming known through the investigations of phytopathologists, and this knowledge enables the wheat breeder to do his work more intelligently.

Finally, as in part pointed out above, breeding for certain physical characteristics such as stiff straw, tight chaff, shape of kernel, dense head, has a tendency to increase yield by purely mechanical means in connection with harvesting by machinery.

III. BREEDING OF SOFT AND DURUM WHEATS

Uses of Low-Protein Wheat

Hitherto, it has been tacitly assumed in the present discussion that the sole objective of the wheat breeder is the improvement of bread wheat; and this is indeed usually true. However, bread is by no means the only form in which wheat is consumed. Very large quantities of flour are used, for example, in cake, cracker, and biscuit making. For these types of products it is not so essential that high-protein wheats be used. The better kinds of moderately soft wheats are entirely satisfactory. The wheat breeder developing wheats for cake and cracker flour need not follow the same objective as the breeder of bread wheats. He may work toward high-yielding, large, plump-berried varieties, provided he does not at the same time permit the quality of the protein to deteriorate too much. While statistical data are not available, it is probable that in countries like the United States with a high standard of living and a large and increasing per capita sugar consumption, the use of flour in cakes, crackers, biscuits, pies, and "sweet goods" generally represents an increasing proportion of the per capita flour consumption. Flour in these forms and also as bread is becoming more and more a vehicle for sugar, fruits, and fats, and less and less a food *per se*. This trend is likely to increase the demand for good soft wheats and to moderate more and more as time goes on the demand of the commercial baker for flours with high protein content. Certainly it means a sharper differentiation of the two types of flour, strong and weak.

Another form in which flour is consumed is in alimentary pastes. These are of two sorts: macaroni and spaghetti types, and noodle types. The wheat requirements of the two are quite different. The best macaroni and spaghetti are not made from flour at all but from semolina. Semolina is granular endosperm free from bran and germ. In the roller-milling process the wheat is not reduced to the fineness of flour in a single operation. Reduction is performed in a series of steps by passing the wheat between successive pairs of rolls, of which the earlier pairs are so adjusted as to produce as little flour and as much coarse granular material as possible. Only after this coarse granular material has been freed from bran and germ by sifting and by air currents is it reduced to the fineness of flour. Before this final grinding, it is known as purified middlings or semolina. It is this material from which the best macaroni is produced. It is obvious that the hardest wheats must produce the most and the largest granules, because their endosperms are hard and

tough; whereas soft wheats with friable endosperms must produce the least. Therefore, the very hardest wheats are preferred for macaroni manufacture. As the durum wheats are the hardest, these are the macaroni wheats *par excellence,* and indeed are so called.[1] They are a drought-resistant, short-growing-period variety, grown principally in dryer sections where, because of their drought and rust resistance, they outyield the common wheats of spring habit of growth. Obviously, in view of the principal uses to which durum wheat is put, the objectives of breeders of durum wheat are not at all points the same as those of breeders of common wheat.

For alimentary pastes of the noodle type, flour too poor in protein content and protein quality to be satisfactory for bread or even cracker and cake may be used. If a breeder desires to develop wheat for this special use he may concentrate his efforts on all those characters that make for high yields. As a matter of fact, wheats are not grown specifically for noodles as durum wheat is grown for macaroni. There is enough soft, low-protein wheat in the world. Moreover, in the production of the higher grades of flour, the so-called patent flours, poorer flour is a by-product which may be used in these softer kinds of alimentary pastes. Indeed, the mills of the Pacific Coast of North America dispose of these flours, so-called clear flours, by exportation to the Orient whenever conditions permit. In the Orient little leavened bread is baked, but there is a considerable consumption of noodles and related products, for which clear flours and flours from club wheats so largely grown in the Pacific Northwest are entirely suitable. The sale of the clear flours in the Orient is much facilitated by heavy bleaching in the mills. It is the demand for yeast-leavened loaf bread that has brought about the insistent demand for high-protein wheat, and the breeder of wheat to be used in pastry or noodles need not make high protein content one of his major objectives.

Finally, wheat is grown for forage and feed as well as for food. In some regions wheat is cut—usually when the seed is in the dough stage—and cured for hay. For this purpose varieties with luxuriant growth are desirable. In other regions winter wheat, if weather conditions are favorable, may be pastured during the winter or early spring, and then permitted to produce a crop. The tillering power and the ability to grow at lower temperatures are important characters if wheat is to be pastured. In some countries the straw has other uses than as feed or manure. For example, straw was largely used in England as a packing material, especially for pottery and other fragile manufactures. Farmers situated close to the seat of such industries obtained a material return from straw and were led to plant varieties with fine, stiff, long straw. As these are often very high-yielding but low-quality varieties, this use of straw unquestionably exerted a material influence on wheat breeding in England. In more recent times straw has been replaced for this purpose by other substances. In some regions, England and California for example, an important use of wheat is as poultry feed. The poultry feeder buys wheat on its appearance, not on chemical analysis. He prefers large, plump, white wheat, and it is reported that in England the grower of such wheat (which there is often rather poor for bread-making purposes) not uncommonly receives more for it from poultry feeders than from millers. Naturally, this has not been without its effect on the choice of wheats there grown. The bran and germ fraction of wheat from which the flour has been removed by the miller is also used for feed. There seems to be a widespread preference for white bran. Why feeders should prefer white bran to red is not clear. Possibly it is because white bran seems to them to contain more flour. In modern milling the by-product, millfeed, is an important item of income. Competition is so keen that the return on the bran must enter into the miller's calculation both in the sale of flour and in the purchase of wheat. Now the color of the bran does not determine the quality of wheat, though it is true that among the high-protein, hard, flinty, vitreous sorts red varieties prevail. There are also high-quality white wheats. In breeding, therefore, the color of the bran coat is a factor to be considered.

[1] But it must not be assumed that good durum and good hard spring wheats (for example, Marquis) of the same protein content behave identically in the making of bread and paste—quite the contrary. Flour from Marquis wheat makes the best bread, and semolina from amber durum wheat makes the best paste.

IV. HISTORY OF WHEAT BREEDING

The breeder in his efforts to achieve the many diverse objectives of wheat breeding, and to give to the farmers of each district the particular variety of wheat that is most profitable under the special conditions prevailing in that district, has to use as foundation stock the varieties of wheat now in existence. These are the raw materials out of which he must create the special wheats for special purposes. To understand the character of his work and the obstacles he has to surmount, it is helpful to inquire how present-day varieties came into existence and how present-day methods of breeding were developed.

Origin of the Wheat Plant

Botanically, the wheat plant belongs to the genus *Triticum*. Botanists are far from agreement concerning the number of distinct species that belong to this genus or of their relationships to one another. Botanists differ also concerning the origin of the different sorts of wheat. Some believe that at least certain of the different kinds were developed each from a single wild species; others, that they arose from accidental hybrids and perhaps also from mutations.[1]

The idea that domesticated wheats may have originated from hybrids of different wild species finds support in the fact that wheat is normally self-fertilized, that is, the seed is the product of the female and male element (pollen) of the same flower. Cross fertilization does occur occasionally without human interference; but the fact that it is the exception rather than the rule favors the maintenance of new varieties arising from hybrids that have appeared either accidentally or as the deliberate act of man. If such a hybrid possesses characteristics that enable it to survive, it will continue to be inbred indefinitely, since it will be self-fertilized. Hence, in the long run, a wheat hybrid will develop into strains or lines that have lost their hybrid character in that they breed true. Each of these strains or lines may represent a new variety since each may contain different combinations of the characters of its ancestors. Thus may be formed what is essentially a new type of plant.[2] If the types are suited to the environment they will survive; if any one new type is better suited than its ancestors it may in time displace them. In the course of the ages many of the varieties of wheat have perhaps developed in this way. There was accidental hybridization. A new type arose. This was better suited to its environment than the types from which it was derived, and for this reason replaced them. Or else it appealed to man as superior, so that it was deliberately selected and propagated.

Deliberate, purposeful plant breeding by hybridization was practiced in ancient times: in China with various flowers; with roses in the Roman Empire; and in the seventeenth century by Dutch flower fanciers. However, no one knew anything concerning the laws of heredity and no one could prophesy the characteristics of hybrids or of their offspring. The method was essentially one of trial and error. Indeed, nothing was known about the sexuality of plants before it was established by Camerer in 1694.[3] Not until 1760 was the first successful scientific hybridization experiment performed by Kölreuter in crossing two species of tobacco.[4] Though the phenomenon was much studied thereafter, its application to the improvement of crop plants remained for more than a century largely a matter of trial and error, for little was known about the laws determining the manner of inheritance by the hybrid of the characters of its parents. Moreover, the difficulties were multiplied because the progeny of hybrids vary in ways that were then quite mysterious; the hybrid usually fails to breed true.

[1] The spontaneous origin of new characters is known as mutation. Individuals with new characters are known as mutants. Little is known concerning how mutation, which is comparatively rare with most plants, comes about. In some cases, certainly, mutants have turned out to be individuals with a hybrid in their more or less remote ancestry.

[2] This is not the place for a full discussion of the laws and mechanism of inheritance. For such a discussion the reader is referred to E. B. Babcock and R. E. Clausen, *Genetics in Relation to Agriculture* (New York, 1927).

[3] *Epistola de sexu plantarum*, quoted by Babcock and Clausen, *op. cit.*, p. 335.

[4] Vorläufige Nachricht von einigen, das Geschlecht der Pflanzen betreffenden Versuchen und Beobachtungen, nebst Fortsetzungen 1, 2, und 3 (1761–1766)," edited by W. Pfeffer, as No. 41, in *Ostwalds Klassiker der Exakten Wissinschaften* (Leipzig, 1893).

Its progeny may be of many types, each representing a different combination of the characters present in the wheats used in the original cross.

Efforts, no doubt, were made by primitive peoples to improve wheat; but the technique used was not that of hybridization, but mass selection. It consists simply in picking out choice plants from the main crop and sowing the seed from them for the next crop. When systematic plant breeding began in Europe in the latter part of the eighteenth century, and soon thereafter in America, this was the general method used. Applied to wheat, which is self-fertilized, no lasting success could be achieved and no new varieties developed unless it happened that accidental hybrids or mutants were selected for propagation. In order to maintain improvement it is necessary to keep on selecting the best plants. Indeed, strains developed by this method have rarely been able to maintain themselves permanently unless based originally on the selection of hybrids or mutants, accidental or artificial. An improvement of the method, though no change in principle, was introduced when single individual plants were selected for propagation. When these happened to be hybrids or mutants, new varieties, which sometimes proved to be of great value, were originated.

Artificial Hybridization

The breeding of wheat by artificial hybridization was begun during the middle of the nineteenth century. It represented an immense advance, since by this method it is possible deliberately to produce new varieties. In the beginning the procedure was relatively simple: two kinds of wheat were crossed, the seed of the hybrid plant was sown, and selection was made from its progeny. Breeders later resorted to multiple crosses: the first hybrid was crossed with another form, and sometimes the hybridization continued for a number of generations.

However, while the introduction of the method of selecting plants with desirable characters from the descendants of artificial hybrids introduced a new era in wheat improvement, nevertheless the work remained rather haphazard so long as the laws of inheritance of characters were not applied to the problems of wheat improvement. Wheat breeders endeavored to help themselves out of their difficulties by seeking correlations between characters. By correlation is meant that two characters which, so far as appearances go, are not physiologically related to each other, seem always to be transmitted together. The idea underlying these studies was that if one could ascertain what traits are inherited together, one should be able to select more intelligently the parents for a cross. For example, if redness of the bran coat were always associated with high protein content, this knowledge would be enormously helpful in the process of selecting the most promising parents for a cross, and subsequently in making selection from among their hybrid progeny.

An immense amount of work was done to establish such correlations as guides in breeding and selecting, but on the whole with but few results of practical value. Such correlations as were uncovered served merely as makeshifts employed by the breeders of the second half of the nineteenth century for lack of real knowledge of the laws of heredity. Yet two of the fundamental laws had been discovered by Gregor Mendel as early as 1865. Unfortunately, his publication was overlooked and remained generally unknown till unearthed by deVries, Correns, and Tschermak about 1900, when Mendel's laws were rediscovered and verified[1] by them and also by Johannsen. Only since that time has a real science of genetics arisen which is capable of explaining many of the phenomena of heredity, and of serving as a guide to the breeder. Only since the turn of the century has truly scientific breeding been possible. Breeders before then crossed varieties on their personal judgment and experience, guided only by what had been established in the way of correlation of characters. The result was largely a question of trial and error; yet in this period some of our most valuable varieties were produced. Noteworthy examples are to be found in Farrer's Australian wheats, Federation and Comeback, and Saunders' Canadian wheats, Marquis and Preston.

[1] For an exposition of the character of these laws the reader is referred to the book of Babcock and Clausen above cited.

Scientific Breeding by Experiment Stations

With the introduction of artificial hybridization, the practice of breeding wheat gradually passed more and more out of the hands of farmers, practical men, amateurs, and seedsmen into the hands of scientists. This is due in part to the fact that as scientific methods began to be applied, scientists naturally had the advantage over amateurs. The main reason, however, is that as systematic methods came into use it was found necessary for the best results to test out many hundreds of progeny of hybrids each year and to grow the plants chosen for propagation over a series of years. All this involves great expense and a long continuance of the work. Few private persons are able to support such work for long. Scientists are commonly connected with permanent institutions, such as agricultural colleges, agricultural experiment stations, universities, or botanic gardens, supported out of public funds or private endowments. These commonly possess the resources and the facilities to undertake large-scale, long-continuing investigations such as nowadays are required in wheat breeding. And so it is not astonishing that at the present time the practice of systematic wheat improvement has passed very largely out of private hands and is now being conducted by agricultural colleges and experiment stations. This does not mean that no new varieties are ever at the present time introduced by others; such introductions are, however, the exception. It happens now and then that a farmer is struck by some individual plant in a field of wheat, saves its seed, and propagates it. If it is a hybrid or a mutant, this may result in the introduction of a new strain or variety. The recent introduction of Blackhull wheat in Kansas is an instance of this kind.

While it is perhaps to be regretted that with the reduction in numbers of the private wheat breeder there has been a loss of individual initiative in crop-plant breeding, there are many compensations. So long as it was possible for private individuals to work successfully in originating new varieties, it happened not infrequently that varieties inferior to those already being grown, or at least not superior, were foisted upon farmers by seedsmen and others as improvements. If the variety caught the farmers' fancy, very considerable profits accrued to the introducer. Occasionally an old and well-known variety was merely given a new name and the seed sold to farmers at high prices. This sometimes happened purely from ignorance. Indeed, so long as there was a great commercial element in wheat breeding, involving the chance for large profits, possibilities of fraud upon the farmer and of injury to the reputation of the wheat from a given locality were serious.

Injury of reputation is a most significant matter. The place of origin of wheat is an important consideration in the minds of purchasers in determining price. It is therefore important that the wheat of a given geographic section be as uniform as possible and consist preferably of but a single variety. The more perfectly a wheat-growing region can standardize its wheat, the more uniform and invariable it is, the greater the sense of security of the buyer. Anything that lessens this uniformity lessens the sense of security of the buyer and induces a correspondingly unfavorable reaction in regard to the price he is willing to pay.[1] The introduction of a new variety, unless it is manifestly superior to those already grown, has this effect. Indeed, there are wheat-growing regions where relatively low average prices are received because many varieties are grown and no one is standard. No doubt one of the factors responsible for the good prices paid for the wheat of western Canada is its uniformity, for it consists predominantly of a few varieties only, indeed largely one. Experiment stations have no commercial interests at stake and painstakingly study new varieties for years and consider the economic effects of their introduction before offering them for general use. Moreover, they carefully test old or new varieties recommended by others, and oppose or encourage their introduction as their respective merits seem to the scientists of the experiment stations to warrant. On the whole, it would seem that the all-important rôle now played by the experiment station brings in its train benefits which rather more than counterbalance the general disappearance of private initiative.

[1] For assurance in purchases, millers map the wheat-growing regions.

V. COMPLEXITY OF THE PROBLEM OF WHEAT BREEDING

Great as has been the progress toward truly scientific breeding, that goal is far from having been reached. There are many obstacles still to be surmounted. One of these is the difficulty of knowing what the characters of the plant as it stands in the field, for example, length of straw, have to do with the characters of its seed. In the last analysis the farmer is interested in the seed rather than in the plant that produces it. The plant is merely a means to an end, a machine to produce seed. Its characteristics interest him only in so far as they determine the quantity and characteristics of the seed harvested.[1] Unfortunately, it is difficult to prophesy from the characteristics of a wheat plant what sort of seed it will produce. How immensely complex are the correlations between the characteristics of the plant itself and of its seed is in part dependent upon the fact that the seed is not exactly a single individual, like the young of animals. It is in fact a sort of pair of twins, because in seed-bearing plants fertilization is in a way double.

In seed-bearing plants both the male and the female reproducing cells, when mature, have two nuclei which in fertilization pair off, giving rise to two new nuclei, one of which produces the embryo, while the other produces the endosperm. The embryo or germ is the new individual; from it the daughter plant develops. It is but a small portion (less than 4 per cent by weight) of the seed, and is situated at one pole of the berry opposite to the crease or furrow that is found along one side of the seed. The endosperm is a relatively large store of reserve food which is utilized in germination by the embryo as it grows into the seedling. It enables the seedling to grow until a root system adequate for drawing nourishment from the soil has been formed. On germination the embryo becomes a parasite upon the endosperm; in its early life the embryo consumes the endosperm in order that it may grow.

[1] This naturally ceases to be true where straw has sufficient value to be a joint product of importance, or where wheat is cut for hay.

[2] The comparison of a seed with a hypothetical pair of dissimilar twins is not, scientifically speaking, strictly warranted; but as a metaphor it is accurate enough to be useful in the present connection.

One may therefore think of a seed as a sort of pair of Siamese twins, but a pair of twins in which the two individuals are not merely dissimilar[2] but in which one, the embryo, becomes a parasite upon the other, the endosperm. It must follow that the correlation of plant characters with the inheritance of endosperm characters is complex; the endosperm, though formed by the same parents, may have a somewhat different inheritance from its embryo twin, just as two children need not necessarily possess exactly identical combinations of the characters of their parents. The miller is not interested in the embryo; he endeavors to remove it as completely as possible from flour and he would pay a premium for wheat without any embryo at all. His interest lies in the other twin, the endosperm. Yet it is through the embryo that the inheritance of endosperm characters is passed down from generation to generation.

It is easy to understand that the wheat breeders of the last half of the nineteenth century encountered difficulties when they endeavored to establish correlations between endosperm and plant characters, i.e., when they endeavored to foretell from the character of the wheat plant what would be the characters of its seed and to predict the characteristics of the seed of its progeny. It is obvious that the establishment of such rules would facilitate breeding immensely. An enormous amount of experimentation was done with comparatively meager results owing to the complexity of conditions. Certain correlations were, however, established in a general way, though subject to numerous exceptions. Some of these are of interest in the present connection.

Established Correlations

It was established that in general, though subject to exceptions, a longer growing period is usually accompanied by greater yield, larger size of individual berry, and, unfortunately, by lower protein content also. As a rule, wheats that produce flour with characteristics desired by bakers of bread, have a high protein content, though to this there are exceptions. Hence, it may be said that generally the highest yields are usually incompatible with the highest

protein content.[1] Large size of the wheat berry, as has been stated, is apt to go with low protein content. Usually, too, glassy or vitreous appearance and translucency of the endosperm indicate high protein content, though not invariably. In short, with some exceptions, a long growing period and high yields go together, and are usually incompatible as a rule with high protein content. To put it still another way, most of the long-growing-period wheats, to which the most widely grown of all wheats, the so-called winter wheats, belong, are usually heavy yielders of the softer kinds of wheat, whereas most of the short-growing-period wheats, the so-called spring wheats, are usually light yielders of the harder, higher-protein sorts of wheats. Under favorable circumstances hard winter wheats have been developed and perfected. For a given variety, cultural conditions which favor a long growing period, such as deep plowing, heavy fertilization, thin seeding, plenty of moisture, result usually in lowering protein content. Climate alone has an immense influence not only on the yield but also on the chemical composition of the seed of a given variety of wheat.

Especially important seems to be the length of the period between flowering and maturity. It seems that as the fertilized flower begins to develop into the seed the protein is deposited in it first; the starch accumulates more gradually later, and over a longer period. Hence, for a given variety, the longer the interval between flowering and maturity the more time is there for starch to be deposited and accumulate in the seed. The proportion of protein to starch in the mature seed must be reduced thereby, though the absolute quantity may not be changed. Therefore, anything that lengthens the period between flowering and seed maturity tends to reduce the percentage of protein in the ripe seed. This usually means a reduction in bread-making quality since, other things being equal, quality for this purpose depends upon the percentage of protein. At the same time it is obvious that, if the protein content does not much change, whereas the percentage decreases due to increasing deposition of starch as the period after flowering is prolonged, the size of the seed must increase and with it the crop yield. And this is in accord with the correlations above mentioned.

Environmental Factors

And so it also becomes obvious that anything that lengthens the period between flowering and ripening should lower protein content and increase yield. A long growing period may be an inherent characteristic of a given variety, but this period may more or less be lengthened or shortened by climate, weather, or method of cultivation. Thus statisticians have established the probability that cool, cloudy, or even rainy weather at the time of flowering favors high yields. The physiological reason for this correlation[2] is that at the time of blossoming there is an enormous increase in the water requirements of the plant because transpiration, i.e., loss of water from the surface of the plant, is greatly increased. The sudden demand for moisture that accompanies blossoming is difficult for the roots of the plant to meet. The result is more or less rapid dessication of the annual plant leading to its final death. The more dessication, the greater the corresponding injury and the shorter the subsequent life of the plant, the smaller the seeds, the smaller the yield, and the higher the protein content. Hence, it follows that anything that reduces transpiration, i.e., the loss of water from the plant's surface, would tend to reduce the extent of the dessication at the time of blossoming, as well as the extent of the injury resulting therefrom and would lengthen the subsequent life of the plant. This in turn would tend to increase yield while reducing the percentage of protein. It is obvious that high humidity of the atmosphere would tend to reduce evaporation. And this explains why rainy and cloudy weather at the time of flowering tend to increase yields. Other things being equal, wind would increase evaporation and tend to have the opposite effect.

[1] It follows that it is obviously unfair, as is done so frequently, to assert that agriculture in one country is more efficient than in another because wheat yields are greater. The character of the varieties it is possible to grow in the two countries with very different climates is probably at least as important a cause of differences in yields as agricultural technique.

[2] This has been established by the experiments at the Food Research Institute. See H. L. van de Sande Bakhuyzen, "Studies on Wheat Grown under Constant Conditions," *Plant Physiology*, January 1928, III, 1–30.

It is obvious, then, that yield and protein content are not solely determined by heredity but that the effects of inheritance are modified by environment from season to season and from place to place. Therefore, it is difficult to know in any one year to exactly what extent the yield and protein content of that year are due to inheritance and to what extent they are due to environment. For this reason a new variety must be tested for many years so as to eliminate the effect of yearly fluctuations in environment before one can estimate the part played by inheritance in determining yield and protein content. In wheat-breeding work it would therefore seem worth while, in addition to growing field plots, to grow a few plants of each variety under test in rooms in which all environmental conditions are kept constant. This does not hitherto seem to have been attempted, but the writer is convinced that the time that could be saved and the information that can be obtained in only this way, not merely concerning protein content but also concerning growth rates at different stages, would many times pay the added cost.

Inheritance of Qualitative Characters

Yield and protein content are characters that are sometimes termed quantitative to distinguish them from other types that are qualitative. A qualitative character is one that is either present or absent; presence or absence of awns and presence or absence of pigment in the seed coat are such characters. A quantitative character is one that is always present but to varying degree. The mode of inheritance of qualitative characters is understood; they obey Mendel's laws. Unfortunately, however, they have little or no economic importance. Grain-yielding capacity, on the other hand, perhaps the most important character to control, like almost all quantitative characters either does not obey Mendel's laws or else does so under conditions so complex that it has as yet been impossible to unravel them under field conditions. Similar conditions prevail for other characters desirable to control, such as length of growing period, resistance to drought, to frost, to lodging (stiffness of straw), to shelling out, and to disease. The conditions under which these characters are inherited seem very complex and are not yet clearly understood. Nevertheless, progress is being made; and even with what is already known, more rapid advance is being achieved in wheat improvement than would have been possible in the days before the recognition of the significance of Mendel's fundamental discoveries.

It must by this time be obvious to the reader that all purposes cannot be met in a single variety of wheat any more than with domestic animals. A horse cannot at one and the same time be an ideal draft animal and also a good racer. The purpose of the wheat breeder is not to produce a single, in all respects ideal, variety, but a series of varieties, each of which is as nearly ideally adapted as possible to the economic conditions of the particular wheat-growing section for which it is designed. Yield will usually be the foremost objective of the wheat breeder; but he must also consider quality. He will oftenest produce varieties that represent a compromise between the highest yielding power and the highest quality. The need for continuing wheat improvement seems unlikely to disappear for many years to come. In the past the objectives of wheat breeders have had to be modified to meet changing conditions of agriculture and of civilization. The wheat that is most profitable for extensive one-crop farming may prove the reverse when the type of farming becomes more diversified and more intensive. The type of flour that is satisfactory to the consumer in one generation may no longer prove so in a later generation, when taste changes and when methods of converting the raw wheat into the food that comes to the table are altered. There will be work for the wheat breeder for years to come, and it is therefore gratifying that so much progress is being made through purely scientific investigations in learning the nature of the fundamental laws of heredity, knowledge of which must inevitably facilitate enormously the approach to perfection in wheat cultivated for any given purpose.

This issue is the work of Carl L. Alsberg, with the assistance of E. P. Griffing

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VOL. IV, NO. 8 JULY 1928

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OF THE

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The Food Research Institute was established at Stanford University in 1921 jointly by the Carnegie Corporation of New York and the Trustees of Leland Stanford Junior University, for research in the production, distribution, and consumption of food.

BRITISH PARCELS PRICES

A WORLD WHEAT PRICE SERIES

The "world price of wheat" is a concept fraught with difficulties of formulation and interpretation. At any given time, even when allowance is made for different currencies and units of measure, the commodity called wheat is sold at very different prices on the thousands of markets scattered over the world. Price differentials arise because wheat is not a homogeneous commodity; because wheat of a given type and quality may be put to diverse uses; because of costs of transportation between surplus and deficiency areas; and because, in spite of a high development of means of communication and transport, local gluts or shortages cause prices in affected local markets to move out of line with those in central markets. One does not expect wheat containing a high proportion of moisture to sell on a given market at the same price as wheat dryer but otherwise the same. Prices of a given grade of hard red winter wheat are not likely to be identical in Dodge City and Kansas City, or in Galveston and Liverpool. If between two seasons prices of comparable wheats rise ten cents in Liverpool but fall fifty cents in an isolated local market in interior China, the fact is not surprising. Durum wheat, which is used in the manufacture of alimentary pastes, cannot be expected to command the same prices as a given grade of bread wheat. Throughout the world there is at any given time a considerable variety and range of wheat prices, surprisingly wide to those outside the trade who are accustomed to think of wheat as simply wheat; and from year to year particular wheats occupy different positions within the range.

If price statistics were available for all of the thousands of markets in which wheat is sold, one might construct a large number of wheat price series that could be regarded, with stated qualifications, as world wheat price series. One might choose prices received by producers everywhere for all wheat sold by them, or prices in all markets through which specified quantities of all sorts of wheat are sold by middlemen; or one might choose to average the prices only of bread wheats in markets recognized as important; and so on. It would obviously be difficult to demonstrate that any series was clearly the one which best represented the world price of wheat for all purposes.

Some simplification of the problem is essential; and most students have preferred, partly in the absence of price statistics on many markets and partly from considerations of logic and convenience, to regard prices registered in the United Kingdom, especially Liverpool, as the most significant world wheat prices, because they are of dominant importance at least to the world wheat trade.[1] The United Kingdom imports more wheat than any other country, and has a large trade in reselling wheat to continental Europe; the wheat traded in is mostly millable bread wheat; tariff restrictions have not disturbed trade and prices in the United Kingdom for many years; the wheat shipping business in all its aspects has long tended to concentrate in the hands of the English, rendering the United Kingdom the world's great entrepôt; wheats from all sources compete more freely and in larger volumes in the United Kingdom than elsewhere; and Liverpool is the most important wheat trading center of the United Kingdom. The wheat price on such a great world market as the United Kingdom or Liverpool, sensitive to world conditions of supply and demand but not dominated by local conditions in any given country, is undeniably among the most significant of several possible world wheat prices.

But in the United Kingdom, as in other markets, there exists at any time a variety

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[1] Similarly the world wheat crop is often discussed, even though deficient statistical data necessitate omission of the large crops of China and Asia Minor and smaller crops of other countries in all years, and of the huge Russian crop in some years.

of wheat prices, not a single price. For one reason or another, no price series in current use seems to be representative of the range; at least no series currently presented is capable of showing with sufficient exactness the general movement of import wheat prices from week to week. The primary object of this study is to present a computed price series of British import wheats, based upon daily quotations of parcels prices.

In order to obtain a reasonably clear view of the world wheat situation over short periods of time, one requires a wheat price series not only representative of the range of import prices in the United Kingdom, but also susceptible of presentation on a weekly basis. With such a series, one may make significant comparisons with representative wheat prices in the important exporting and importing countries of the world. Furthermore, the price series representative of the range of United Kingdom prices is desirable for comparisons displaying the usual price relationships of particular types and grades of wheat to the average, and such deviations from the usual relationships as occur over short periods of time.

For these purposes at least, the British parcels price series in the form of weekly averages, here presented for the first time, appears more satisfactory than any series available. It fulfils certain important requirements. It is continuous in time, without gaps and free from "splicing"; it is adequately representative of the range of import wheat prices in the outstanding international market; it permits short-time fluctuations to be followed; it is available without undue lapse of time; and it is reasonably easy and inexpensive to compute. The better to reveal its nature and significance, this series is compared with a number of other series of wheat prices in the British markets.

CONSTRUCTION OF THE SERIES

The wheat arriving in the United Kingdom from exporting countries comes partly in cargo lots in tramp vessels, partly in "parcels" in cargo liners, cargo and passenger liners, or tramps. These "parcels" may represent anything from a few thousand bushels up to more than a hundred thousand.[1] The wheat is unloaded chiefly at London and Liverpool, but in part also at Manchester, Hull, Bristol, and Glasgow. The *Corn Trade News* and the *London Grain, Seed and Oil Reporter* publish daily the price (in shillings and pence per quarter) at which each cargo or parcel is sold. Some parcels and cargoes are sold "spot," some "due," some "sailing" or "shipped" on a particular date, some "to arrive" at a particular time. Sales probably represent predominantly transactions between the importing merchant who owns the wheat and the miller who intends to use it. Not all of the wheat imported into the United Kingdom is included in the parcels and cargo sales, chiefly because some wheat is shipped directly from exporters to millers, and transactions between them are not recorded on any market. One may assume, however, that prices of such wheat would ordinarily conform fairly closely to prices registered in the open market.

A series of average daily prices which included all "spot" sales both of cargoes and of parcels at all ports, weighted if possible by quantities sold, would seem most likely to represent import wheat prices in the United Kingdom in their most generalized form. The same for Liverpool or London rather than all ports would perhaps serve equally well; theoretically better, indeed, if precise price comparisons are sought, because there may normally be slight differentials between prices in different markets of the United Kingdom. In practice, however, we have found it necessary to be content with something less than this.

Our series of British parcels prices is an unweighted simple average of prices reported for each day's sales of parcels. From the *London Grain, Seed and Oil Reporter* a summation is made of the prices of all sales of parcels to all ports reported as of a given day, whether or not the sales are spot or to arrive. The sum is divided by the number of sales reported, to reach a daily average; weighting is impossible because the size of each parcel is not reported. The

[1] In exporting and shipping circles the standard parcel is commonly regarded as 40 thousand bushels.

resulting figures, in shillings and pence per quarter of 480 pounds, are converted into dollars per bushel of 60 pounds. Conversions from English to United States currency are made at par of exchange since June 1, 1925, when England was again on the gold basis, and previously at noon cable transfer rates of exchange.

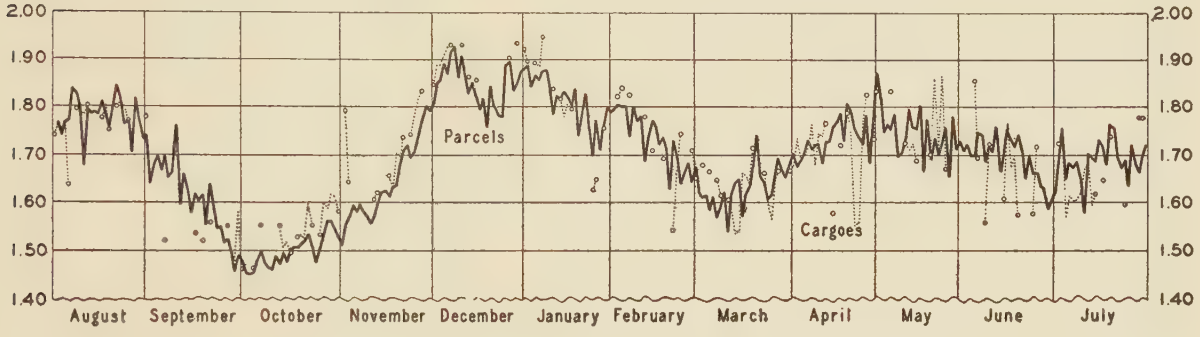
It will be observed that we have disregarded the fact that parcels are sold both "spot" and "to arrive." One seeks, of course, a price for wheat actually laid down in the United Kingdom, not for wheat about to be laid down in the course of some weeks. But most of the sales are in fact either "spot" or "to arrive" within a few days; the exceptions seem not to be numerous, though the proportion of these to all sales varies at different times. The labor of separating spot sales from sales to arrive—and especially the near from the distant to arrive sales—is considerable, and appears to have too small an effect on the curve of prices to be worth the additional labor.

We have also taken no account of the particular port of the United Kingdom to which parcels sales are made. There are relatively few sales of wheat shipped to Manchester, Hull, Bristol, Glasgow, and other ports; the great bulk of the wheat goes to Liverpool and London. The differences between London and Liverpool parcels prices for the same grade of wheat on the same days are slight; and the inclusion of sales to all ports gives a number of sales resulting in a more representative average than could be secured from the sales to any single port. If exceedingly precise comparisons of prices are sought, it would of course be desirable to obtain an average either for London or Liverpool; but extreme precision for some purposes seems less desirable than more representative averages calculated from considerable numbers of price quotations daily.

The exclusion of prices of cargoes deserves fuller explanation. Sales of cargoes do not occur every day when the markets are open. This is shown by Chart 1, which gives a comparison of daily average parcels prices with daily weighted average cargo

CHART 1.—BRITISH PARCELS AND CARGO PRICES, DAILY, 1925–26*

(U.S. dollars per bushel)



* Derived from data in *London Grain, Seed and Oil Reporter.*

prices in 1925–26.[1] The solid line connects the daily average parcels prices. The light dotted line connects average weighted cargo prices for periods when sales were recorded on two or more successive business days. The hollow circles represent either isolated days when sales of cargoes were reported (days when there was no sale on the preceding or following day or days), or days at the beginning and end of a brief period during which sales were reported on successive business days. In the course of the year 1925–26 out of 301 business days there were 136 on which no cargo sales were reported. The chart shows that prices of parcels and of cargoes move in the same general direction, as would be expected; but in certain rather numerous instances cargo prices are far above the average parcels price for the day, while in other instances they are far below it. The explanation lies in the fact that on a par-

[1] The size of each cargo sold is reported; consequently cargo prices can be and have been weighted by volume.

ticular day the only cargo sold may consist of a premium or discount wheat, while sales of parcels may be numerous and may consist of premium and discount wheats about equally. If cargoes were sold on every business day, and if on each business day a sufficient number of cargoes of diverse sorts of wheat were sold to permit averages comparable from day to day to be drawn, then the weighted cargo price would be as good as or better than any. But since these conditions do not hold, little is to be gained by taking account of cargo sales in any way.

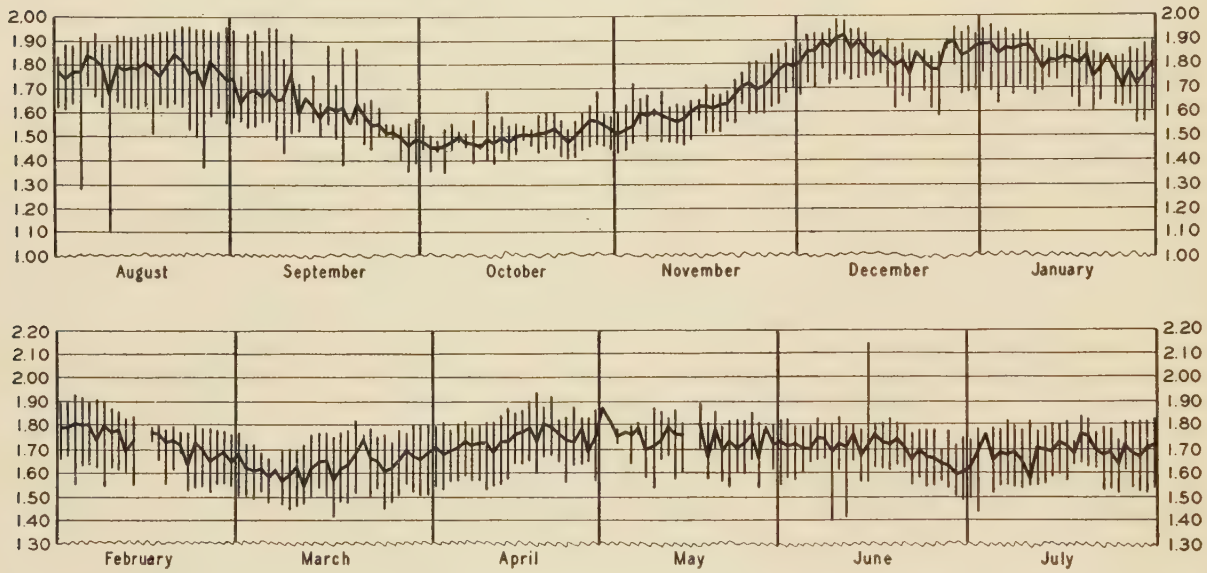
It is impossible to weight the parcels prices by volume because volume is not reported; hence one cannot construct a weighted price of cargo and parcels sales combined. There is furthermore no way of ascertaining how great are the relative volumes of cargo and parcels sales; hence one cannot combine the weighted average daily cargo price with the unweighted average daily parcels price by ascribing a given weight to each. The alternative is to include sales of cargoes in an unweighted combined cargo and parcels price, disregarding differences in size between cargoes and parcels. Judging from tests that we have made, this procedure would yield series differing almost imperceptibly from the unweighted parcels price, because sales of cargoes are relatively few in number. To omit the cargo prices altogether is therefore justifiable merely to render computation easier.

The relation of the daily average parcels price to the range of daily parcels prices from which it is calculated is illustrated in Chart 2, which shows the data for the year August–July 1925–26. The range is seldom less than 10 cents per bushel, and then only when the number of parcels sold is very small. It usually approximates 20 cents per bushel, and on some days exceeds 50 cents. A range as wide as 50 cents, however, is distinctly exceptional, and is usually due to the sale of a single parcel of discount wheat at a price far below the modal price of the day. On August 7, 1925, for example, the range of parcels prices was from $1.28 to $1.92 per bushel; but there were 33 parcels sold on that day, and 32 of them were sold at prices ranging from $1.56 to $1.92 per bushel. Since the daily range of parcels prices ordinarily falls between 20 and 30 cents per bushel, it is clear that the use of a price series for a single grade of wheat as a British import price may prove misleading, especially if the grade chosen does not consistently maintain its relative price position with respect to other grades.

The simple arithmetic average of daily

Chart 2.—Daily Range and Average of British Parcels Prices, 1925–26*

(U.S. dollars per bushel)



* Derived from data in *London Grain, Seed and Oil Reporter.*

parcels prices seems to be as satisfactory as any less simple average; it is at once the most familiar and the easiest to compute. The number of sales of parcels is ordinarily sufficient to permit the calculation of representative averages. In 1925–26 the number of parcels sold per business day averaged 15. Between 10 and 30 parcels were sold daily on 193 business days out of 301 in the year; between 31 and 62 parcels were sold on 22 days; and between 1 and 9 parcels were sold on 84 days. Less than 5 parcels daily were sold on only 28 days out of 301; there were only 7 days in the year when but one parcel was sold, and two days when no parcel was sold. There were very few days in which parcels of only one grade of wheat were sold.

In view of these characteristics of the original data, it seems clear that arithmetic averages of parcels prices result in a series of daily prices which may be regarded as reasonably representative of the prices of all wheat entering the United Kingdom. The series is practically continuous, it can be made to yield daily figures, and it is easy to compute. Moreover, it can be computed without great lapse of time, since the original data ordinarily reach even the distant sections of the United States not more than two weeks after the date of issue.

In subsequent pages we have chosen to present weekly averages of parcels prices. These are simpler for use in the study of price relationships extending over periods of several years; moreover, the computation of weekly averages serves to obviate the unrepresentative quality of daily prices on occasional days when only a few or no parcels were sold. Weekly average parcels prices are computed on the basis of weeks ending on Saturday; summations of all sales throughout each week, in terms of English currency, are divided by the number of sales made in each week. The resulting figures have been converted to United States currency at par after June 1, 1925, and at weekly average noon cable transfer rates of exchange before that date. Subsequent charts show parcels prices over six years, from August 1922 to June 1928; data are from daily issues of the *London Grain, Seed and Oil Reporter* except for 1922–23, when weekly issues of Broomhall's *Corn Trade News* were used.[1] The weekly data, showing high, low, and average parcels prices in terms of both English and United States currency, are given in Appendix Table I. Weekly average parcels prices in terms of United States currency appear in Chart 3. Chart 4 shows monthly average parcels prices; and other charts show five-week moving averages of weekly average parcels prices.

COMPARISONS WITH OTHER SERIES

In searching for some British series of wheat prices worthy to be selected as a world price, one encounters several other possibilities. Cargo prices have already been considered, and have been found unsatisfactory. There remain the prices of Liverpool wheat futures, the prices of imported wheat as obtained from foreign trade statistics, the prices of straight-run flour converted into terms of wheat, and the prices of several grades or varieties of wheat. Futures prices are perhaps most commonly employed in discussions of the world wheat price, and the prices of particular grades are also commonly used. The customs prices are less familiar, and the prices of straight-run flour in terms of wheat have never before been computed so far as we are aware. In subsequent pages these series are compared with the series of British parcels prices, without attempting any detailed analysis of the deviations but with a view to testing the relative merits of the parcels series.

Chart 3 (p. 294) shows British parcels prices weekly compared with weekly averages of Liverpool futures. The futures prices are arranged so as to show in any week the prices of the nearest future, and, during the last four weeks in which the nearest future is quoted, the prices of the next most distant future as well. Thus the March future is shown alone throughout January and February, but in contrast with the May future in the closing month of March.

The first objection to the use of Liverpool

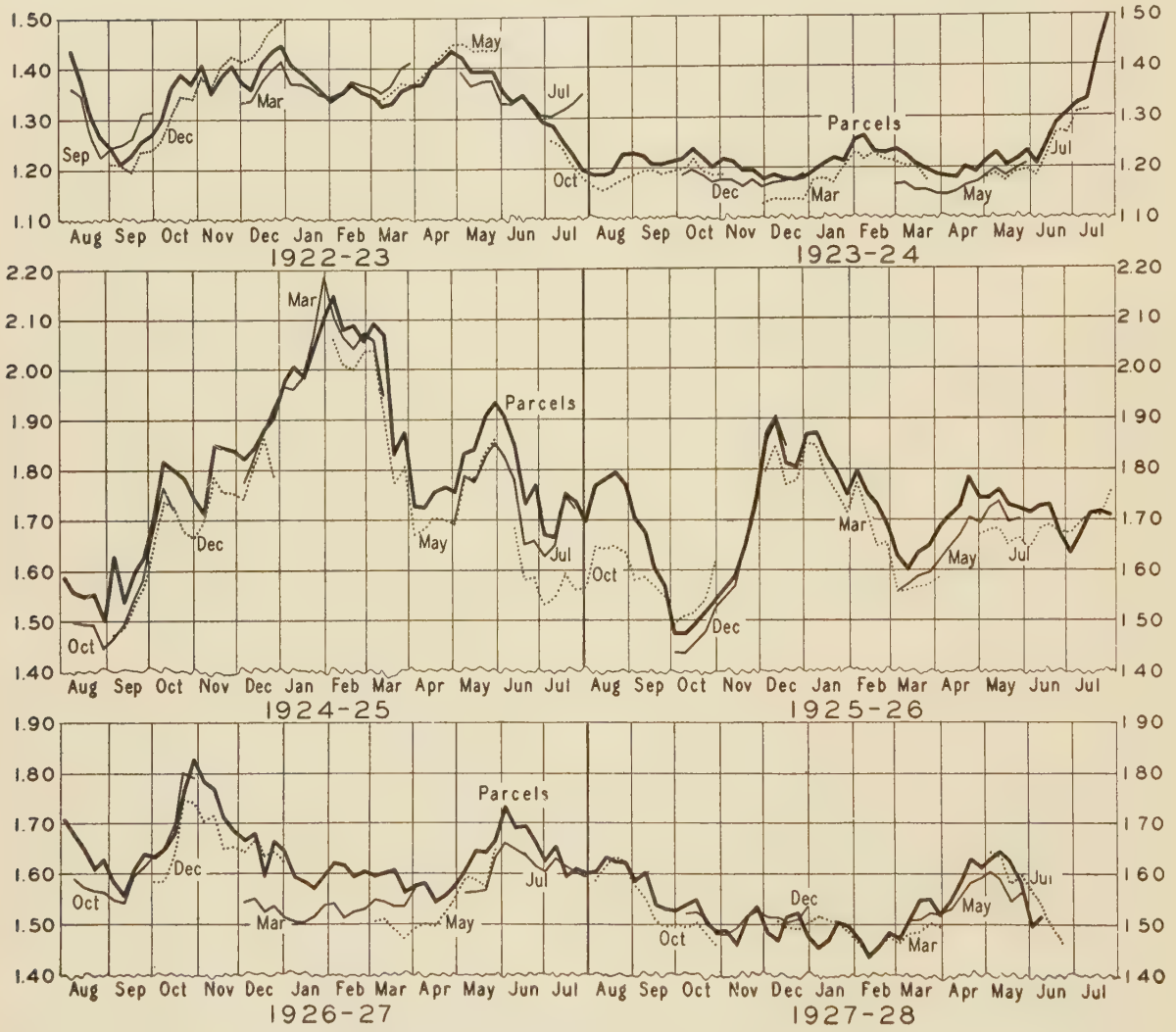
[1] The shift was made only because daily issues of the *London Grain, Seed and Oil Reporter* for 1922–23 are not in our files. There appears to be no significant difference between parcels sales reported by the two journals.

futures prices as representative of British import prices is the fact that transactions in wheat futures do not, except in a small degree, portray the prices at which wheat actually changes hands. Only those who buy a future and hold it in order to receive delivery in the closing month actually pay for wheat what they pay for a wheat future. The number of bushels of wheat bought and sold on the Liverpool futures market, as on other contract markets, much exceeds the number of bushels finally delivered on futures contracts.

In the second place, the futures price at a particular time may be said in some part to represent the collective opinion of traders respecting what the price of cash wheat will be in the delivery month, not their judgment as to the proper current price of cash wheat. Thus there may be periods when little cash wheat is available and its price is high, but when there is

CHART 3.—BRITISH PARCELS PRICES AND LIVERPOOL WHEAT FUTURES PRICES, WEEKLY FROM AUGUST 1922*

(U.S. dollars per bushel)



* Parcels prices as shown in Appendix Table I, computed from daily quotations in *London Grain, Seed and Oil Reporter* and *Corn Trade News;* futures prices from data in Russell's *Market News,* and from *Daily Trade Bulletin.*

reasonable expectation that plenty of wheat will be available in the course of the delivery month, and the futures price is relatively low. Moreover, within a given crop year, spreads between the prices of each future and the cash price tend to become smaller as carrying charges, normally heaviest in the early life of a given future, diminish also. A rough tendency for spreads between futures and cash prices to decrease, whether because of diminishing carrying charges or because of anticipations of increasingly easier cash wheat positions, is shown in Chart 3. The various futures ordinarily close much nearer to the parcels price than they run for several months preceding the date of closing.

On some occasions the future price is above the parcels price in closing months. This is a relationship not ordinarily to be expected. The Liverpool future is a "Graded Red Wheat" future; the wheats ordinarily deliverable and delivered on futures contracts are United States or Argentine wheats. These wheats are ordinarily lower in price than Canadian wheats, at least No. 1 and No. 2 Northern Manitoba, and also than Australian wheat. Consequently their prices ordinarily fall below the average of parcels prices, which is made up from all kinds of wheat. Hence the futures prices in closing months ought to fall close to and usually below the average parcels prices. But there are occasions when this does not occur, because the normally high-priced wheats do not maintain their normal premiums. Throughout 1922–23, for example, the successive futures closed at prices well above the parcels prices. This was broadly due to the fact that there was, on the one hand, an unusual amount of No. 1 Northern Manitoba available following a Canadian crop of which 66 per cent of the spring wheat inspected in the western division graded No. 1, a much higher proportion than in any other year from 1922–23 to 1927–28. Hence No. 1 Northen Manitoba weighted the parcels price heavily, and its price, instead of ranging as high above the parcels price as usual (see Chart 6, p. 299), moved close to the parcels price. On the other hand, United States wheat tended to run higher than No. 1 Northern in some periods of the year (see Chart 7, p. 300). The situation appears to have been one in which grades of wheat deliverable on futures contracts were premium rather than discount wheats. The precise facts, however, are not shown by the several charts; analysis of daily prices would be required for exact study of the relationships. Enough has been said to indicate that a third objection to the use of futures prices lies in the fact that they represent, other things being equal, the price movement of deliverable grades of wheat, and hence in different years may bear different relationships to the average price movement of all grades, just as the prices of single grades of wheat may do.

The final objection to the use of futures prices arises from the necessity of splicing or otherwise adjusting if one is to secure a continuous series. It is readily apparent from Chart 3 that there are occasions in closing months when the closing future ranges 10 or 20 cents above the succeeding future. Splices could be made, for example by averaging the price of the closing with the price of the active future for a day, a week, or a month. But such splicing would create artificial humps or dips in the price curve; and to obviate this difficulty would require more labor than the computation of a useful cash price series. Reasonably precise international price comparisons could not be made by using spliced futures prices, for in most years the spreads between active and succeeding futures are so wide in five out of twelve months that the price movement in those five months could not be expressed clearly.

Chart 4 (p. 296) shows average monthly parcels prices in contrast with weighted monthly average prices of all wheat imported into the United Kingdom. The monthly average parcels prices are obtained by adding all sales of parcels in the four or five weeks falling wholly or principally in a given month and dividing by the total number of sales. The other series, which for convenience may be termed weighted customs prices, is derived from official reports of quantities and c.i.f. values of wheat passing through the British customs monthly. For a picture of the price of British import wheat extending over long periods, this series is probably the best obtainable. It is continuous, weighted, covers all wheat imported, is easy to secure, and is in no

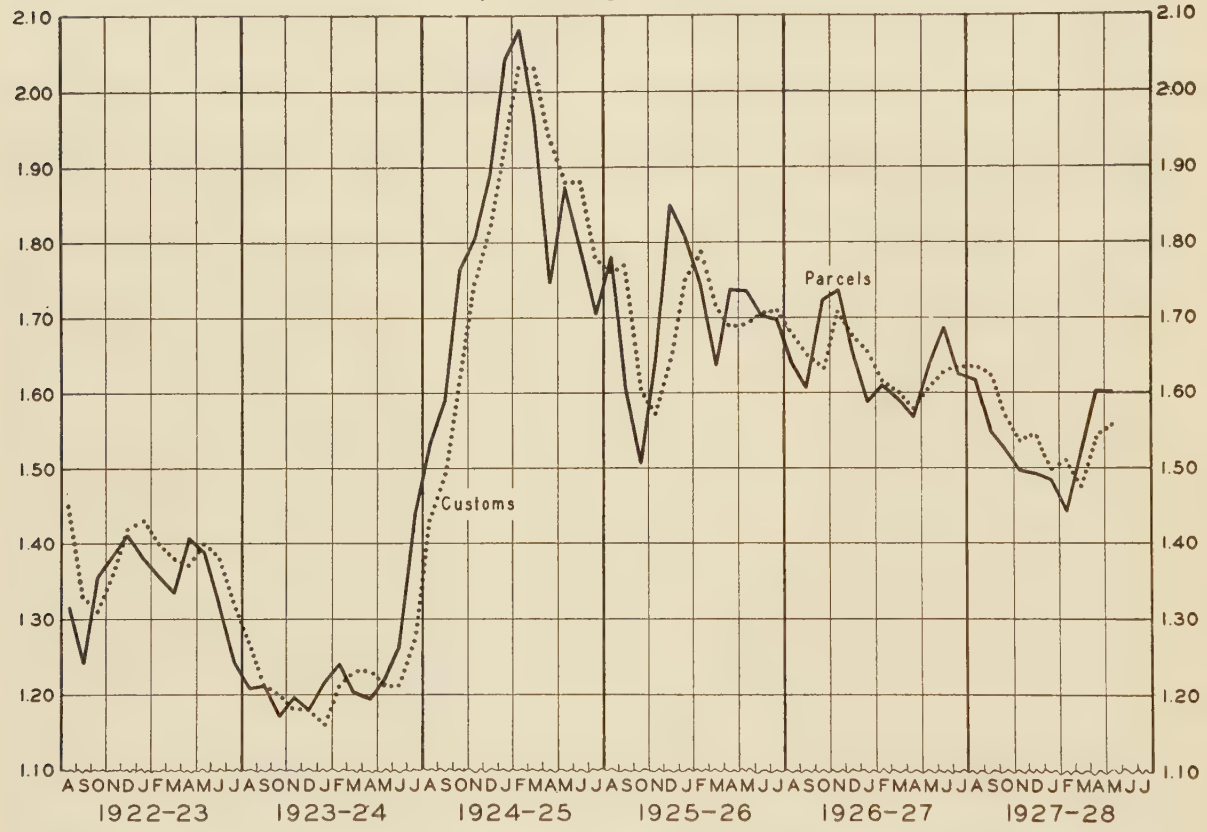
way ambiguous. But it does not lend itself well to use in short-time analysis and comparison; the data become available only after some delay, and cannot be computed on a weekly or a daily basis.

In their broad outlines, the movements of the two series shown in Chart 4 are distinctly similar. When the general movement is upward, however, weighted customs prices fall below parcels prices for identical months, as is most clearly apparent from May 1924 to February 1925. When the general movement is downward, weighted customs prices remain above parcels prices. Hence the price shown by one series frequently differs considerably from that shown by the other series; the difference often exceeds 10 cents per bushel. But the discrepancy is more apparent than real, and is due merely to the fact that weighted customs prices lag behind parcels prices by about a month. If the weighted customs prices were plotted with the parcels prices for the preceding month, the two curves would be almost identical. The lag arises because British importers buy much of their wheat on contracts dated several weeks before the wheat is delivered; and a good deal of this wheat is presumably entered in the customs reports in large part at the prices at which it was purchased. On the whole the lagging correspondence of these two price series tends to support the view that the parcels price represents satisfactorily the range of British import prices. Since the lag is readily explicable and there is a close correspondence of parcels and customs prices when allowance is made for lag, the parcels price appears almost equally satisfactory even for a monthly series.

The monthly parcels price is apparently

CHART 4.—BRITISH PARCELS AND WEIGHTED CUSTOMS PRICES, MONTHLY FROM AUGUST 1922*

(U.S. dollars per bushel)

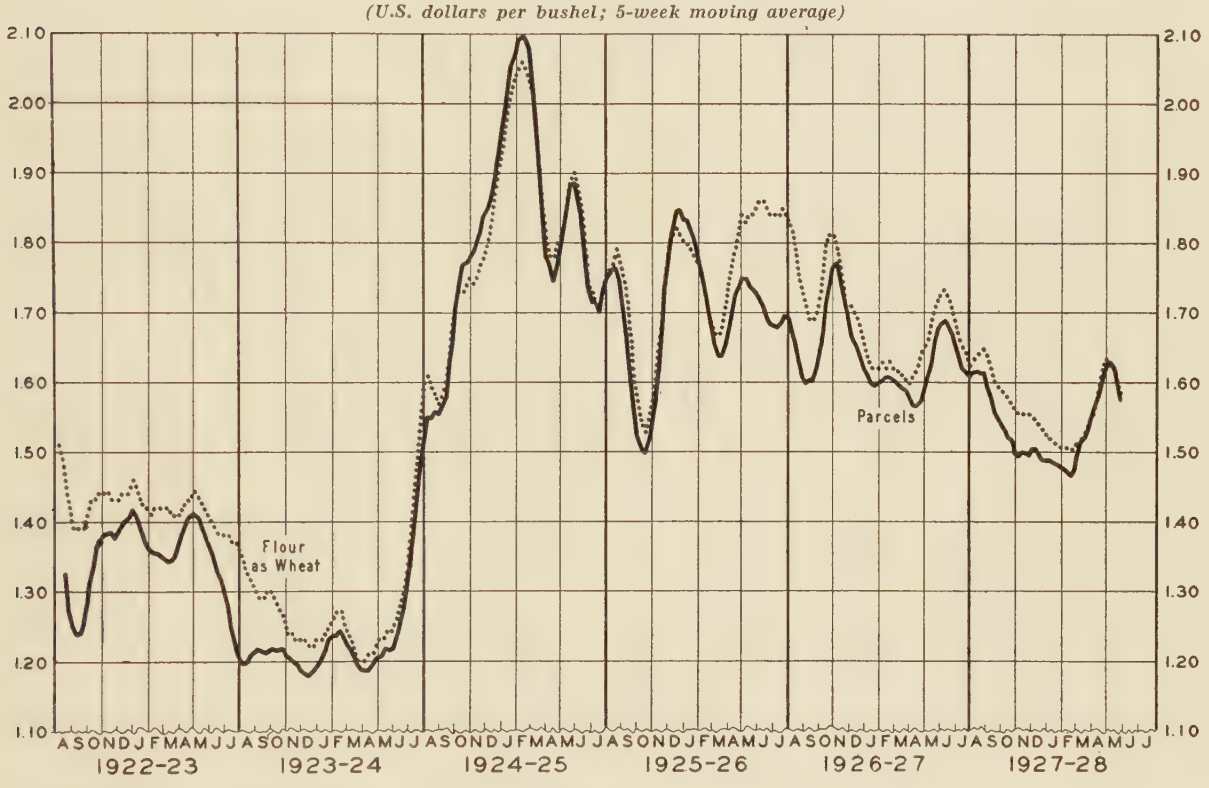


* Parcels prices are four-week or five-week averages; weighted customs prices derived from data in *Accounts Relating to Trade and Navigation of the United Kingdom.*

more sensitive than the weighted customs price; the fluctuations are somewhat wider. Thus the peak of parcels prices in February 1925 was 5 cents higher than the peak of weighted customs prices; and the low point of parcels prices in October 1925 was 7 cents lower than the low point of customs prices reached a month later. Certain fluctuations in parcels prices do not appear at all in customs prices. Thus parcels prices declined about 20 cents per bushel between March and April 1925, while customs prices declined only 5 cents between April and May; and a rise of 12 cents in parcels prices between April and May was not reflected in customs prices between May and June. Other less striking examples may readily be observed on the chart. Since customs prices include a larger element of forward sales and presumably cover larger quantities of wheat than parcels prices, the smaller fluctuations of customs prices are not surprising. The more sensitive series is of course more satisfactory for analysis and comparisons of short-time movements.

Chart 5 shows parcels prices compared with the prices of straight-run flour in London in terms of wheat equivalent, both expressed as five-week moving averages in order to eliminate erratic fluctuations and to render clear the general relationship. The flour prices are Monday prices from the *Corn Trade News*, quoted in terms of shillings per sack of 280 pounds, subsequently converted to dollars per barrel of 196 pounds, and finally expressed in dollars per bushel by assuming a 70 per cent extraction. Prices of straight-run flour in terms of wheat at first glance seem appropriate to represent the range of British wheat prices in much the same manner as the prices of steel represent the prices of pig iron. Straight-run flour is a homogeneous commodity, produced from the mixture of wheats which will yield uniformly the same commodity from week to

CHART 5.—BRITISH PARCELS PRICES AND LONDON STRAIGHT-RUN FLOUR PRICES IN TERMS OF WHEAT, WEEKLY FROM AUGUST 1922*


(U.S. dollars per bushel; 5-week moving average)
2.10
2.00
1.90
1.80
1.70
1.60
1.50
1.40
1.30
1.20
1.10
Flour as Wheat
Parcels
A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1922-23
1923-24
1924-25
1925-26
1926-27
1927-28

* Flour prices derived from weekly (Monday) quotations in *Corn Trade News*.

week and year to year at the lowest possible cost to the millers; and it is sold in large quantities. The flour price ordinarily follows the parcels price rather closely, usually somewhat above because costs of conversion are presumably included in the flour price; but it is slightly less sensitive, and at times gets rather far out of line. Such was the case in May–September 1926, when the British coal strike and attendant circumstances caused flour prices to remain farther than usual above wheat prices. In view of the difficulty and doubtful accuracy of our procedure in converting Monday flour prices to wheat prices by assuming a rate of extraction constant at 70 per cent, and in disregarding altogether such influences on flour prices as the prices of offals, we are not inclined to stress the usefulness of the flour price series. It serves, however, to illustrate how closely wheat and flour prices move together in the United Kingdom; and indirectly it suggests that the parcels price series is truly representative of wheat prices in the United Kingdom. The absence of lag between the two series suggests that the parcels price series, while sensitive, is not unduly so.

PRICES OF PARCELS AND OF PARTICULAR TYPES OF WHEAT

The British parcels price series is not homogeneous in the sense that it represents the same kind of wheat at all times. The stream of wheat whose price it represents varies in character as well as in volume. Always it is made of wheats of different types and qualities, from different exporting regions. At times American wheat predominates; at times Canadian; at times Argentine. It follows that shifts in the level of the parcels price reflect not merely changes in supply and demand, but changes in average quality as well.

Consequently, at first glance, it would seem desirable to secure homogeneous series of prices of particular types and grades of wheat that are important in the British market. In practice, no satisfactory continuous series of this sort can be obtained, for there are periods in which certain types or grades are entirely off the British market, or are present in very small quantities. Moreover, the milling qualities of particular types (and even of particular grades) are not constant. For this reason and others, consistent differentials between different types and grades do not prevail. Hence series of prices of particular wheats are not suitable expressions of British import or world wheat prices. It is, however, instructive to compare certain of these series with the series of British parcels prices.

Charts 6–9 (pp. 299–302) show five-week moving averages of weekly average parcels prices and of the prices of important types of wheat either on Tuesday or Friday of each week. In most instances the prices of particular grades are for spot wheat at Liverpool. These series have been chosen because they are more readily compiled than equivalent series which could be secured from parcels price quotations; because they include most of the important types and grades of wheat which enter the United Kingdom; and because they are the series most commonly referred to in trade journals and other discussions of wheat prices. There are some omissions, for example of No. 2 Northern Manitoba, of United States spring wheat, of South Russian wheat; but the four charts taken together give a general picture of the price relationships at least among the principal imported wheats. Five-week moving averages have been employed in order to smooth the curves,[1] and to emphasize the general relationships prevailing over a period of weeks or months which do not appear so clearly from weekly data.

One feature is common to all charts: there is only one type of wheat, Australian, for which continuous quotations over the six-year period can be obtained. This fact alone favors the use of the parcels price, because the parcels price series is continuous and records the fact that wheat of one kind or another, if not of any single type, is sold on the international market every business day. The parcels price series thus affords a sort of central or average price. It provides a datum line from which the deviations in price of particular types of

[1] The extent to which five-week moving averages of weekly parcels prices smooth the curve is apparent from a comparison of Chart 3 with Charts 5–9.

wheat can be perceived readily and measured, and it facilitates discussion of "normal" price relationships. Detailed analysis of the varying relationships of particular prices from parcels prices are not within the scope of this study. The variations

CHART 6.—BRITISH PARCELS PRICES AND PRICES OF NO. 1 AND NO. 3 NORTHERN MANITOBA WHEAT AT LIVERPOOL, WEEKLY FROM AUGUST 1922*

(U.S. dollars per bushel; 5-week moving average)

2.30
2.20
2.10
2.00
1.90
1.80
1.70
1.60
1.50
1.40
1.30
1.20
1.10
No. 1 Manitoba
No. 3 Manitoba
Parcels
A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1922-23
1923-24
1924-25
1925-26
1926-27
1927-28

* No. 3 Manitoba prices derived from weekly (Tuesday) quotations in *Corn Trade News;* No. 1 Manitoba prices from weekly (Friday) quotations in *International Crop Report and Agricultural Statistics,* supplemented from January 31, 1928, by weekly (Tuesday) quotations in *Corn Trade News.*

themselves are numerous, and the reasons for them still more so. Enough may be said to illustrate the diversity of causes; but the charts are presented merely to emphasize the fact, not too commonly recognized, that wheat price relationships in the United Kingdom are far from stable, and that analysis of them is simplified by the use of a representative central price series.

Chart 6 shows the prices of No. 1 and No. 3 Northern Manitoba in comparison with parcels prices. No. 1 Northern is never a discount wheat; but the extent to which it is a premium wheat varies from year to year. Following the exceptionally large proportion of No. 1 Northern in the good Canadian crop of 1922, it was at an exceptionally low premium in 1922–23. In that year No. 1 Northern constituted 66 per cent of the 229 thousand cars of Canadian spring wheat inspected in the western division. In 1926–27, No. 1 Northern constituted only 9 per cent of the inspections of 254 thousand cars, and commanded an exceptionally high premium after new-crop wheat reached the market in November 1926. In 1927–28 also No. 1 Northern sold

at an exceptional premium; the wheat crop of 1927 contained a still smaller percentage of No. 1 Northern, though complete data are not yet available. Toward the end of the crop year this grade was so scarce that it was not quoted at Liverpool. No. 3 Northern is usually sold at a slight discount, though in certain periods it commands a premium. During 1927–28 this grade brought exceptionally high prices, not so much because relatively little of it was harvested as because the amounts of No. 1 and No. 2 Northern available were relatively small.

Chart 7.—British Parcels Prices and Prices of No. 2 Winter and Pacific White Wheat at Liverpool, Weekly from August 1922*

(U.S. dollars per bushel; 5-week moving average)
2.20
2.10
2.00
1.90
1.80
1.70
1.60
1.50
1.40
1.30
1.20
1.10
Parcels
Pacific White
No. 2 Winter
A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1922-23
1923-24
1924-25
1925-26
1926-27
1927-28

* Prices of No. 2 Winter and Pacific White derived from weekly (Friday) quotations in *International Crop Report and Agricultural Statistics,* supplemented from February 7, 1928, by weekly (Tuesday) quotations in *Corn Trade News.*

Prices of two types of United States wheat, Pacific White and No. 2 Winter, are shown in contrast with parcels prices in Chart 7. Prices of these wheats move less closely with parcels prices than do Canadian wheats, largely because they pass to the United Kingdom in smaller volume. Moreover, the meaning of price quotations for Pacific White wheat is not always clear, for the wheat is not graded like the Canadian; in some years it may be of better milling quality than in others, and this may affect its relative price.[1] Pacific White is sometimes a premium, sometimes a discount wheat; but the factors affecting its position may vary from year to year. Thus it commanded a relatively high premium in 1922–23 not because the supply was abnormally small, but because Canadian wheats which weighted the parcels price heavily were abnormally cheap; whereas

[1] Canadian grades, however, may not mean precisely the same thing from year to year. During the past crop year there have been complaints that No. 1 Northern has proved progressively less satisfactory for milling in the past few years.

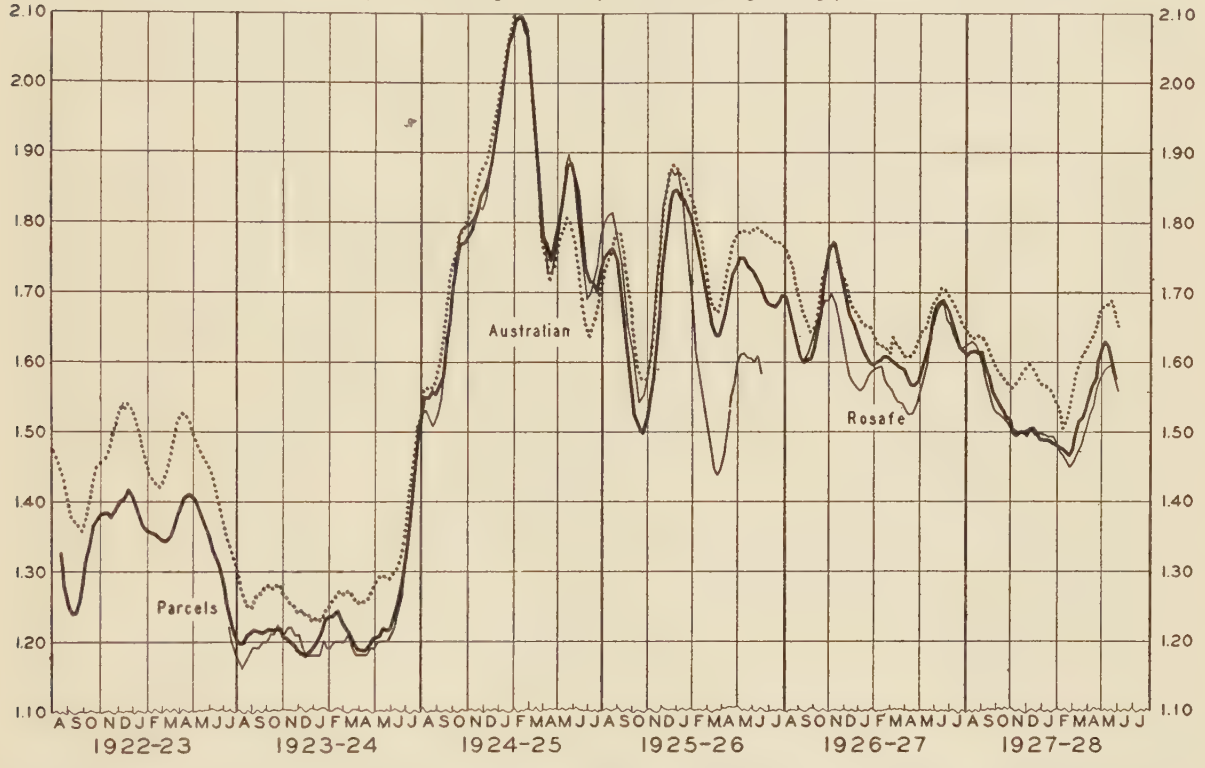
in the first half of 1927–28 a large crop of rather poor quality led to a discount. The smallest crop of Pacific White wheat in the past six years was harvested in 1924; nevertheless Pacific wheat sold at a large discount in the latter part of the crop year 1924–25, presumably because Australian wheat, with which it competes, was cheap following a huge crop.

The meaning of price quotations for No. 2 Winter wheat is also somewhat ambiguous. This wheat seems sometimes to be No. 2 Red Winter, sometimes No. 2 Hard Winter; and these grades are not ordinarily interchangeable for milling purpose since one is soft and the other hard. Quotations are not continuous; there was practically no export of either grade in most of 1925–26, when the United States crop of winter wheat was short. Usually No. 2 Winter appears to be a discount wheat, though it has sold at a premium in a few periods. In October–November 1922, for example, the railway shopmen's strike in the United States appears to have curtailed the export movement and created a temporary shortage of United States winter wheat in the United Kingdom, which in turn led to relatively high prices; and meanwhile Canadian wheat was abnormally cheap. Again in November–February 1926–27 No. 2 Winter commanded a premium, on this occasion largely on account of misinterpretation of the world supply situation accompanying disturbances of trade and prices caused by a sharp advance and decline in ocean freight rates. As the situation clarified, No. 2 Winter fell to an unusually heavy discount. After December 1927, with poor winter wheat prospects in the United States, No. 2 Winter again rose to a premium.

Australian and Argentine wheat prices compared with parcels prices appear in Chart 8. These two series, like the Pacific White price series, do not apply to a single grade of wheat uniform in quality from

CHART 8.—BRITISH PARCELS PRICES AND PRICES OF AUSTRALIAN AND ARGENTINE (ROSAFÉ) WHEAT AT LIVERPOOL, WEEKLY FROM AUGUST 1922*

(U.S. dollars per bushel; 5-week moving average)


2.10
2.00
1.90
1.80
1.70
1.60
1.50
1.40
1.30
1.20
1.10
Australian
Rosafe
Parcels
A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1922-23
1923-24
1924-25
1925-26
1926-27
1927-28

* Australian prices derived from weekly (Friday) quotations in *International Crop Report and Agricultural Statistics*, supplemented from February 7, 1928, by weekly (Tuesday) quotations in *Corn Trade News;* Rosafé from weekly (Tuesday) quotations in *Corn Trade News.*

year to year, though Australian does not vary much. Australian wheat usually commands a premium, highest following small crops, as in 1922–23, 1923–24, 1925–26, and 1927–28. It was a discount wheat only for some months after harvest of the huge crop of 1924. Argentine (Rosafé) wheat prices, except under special circumstances, follow the parcels prices rather closely, usually at a discount, sometimes at a premium. The crop harvested in January–February 1926, however, was so poor in quality that a heavy discount appeared and was maintained for several months.

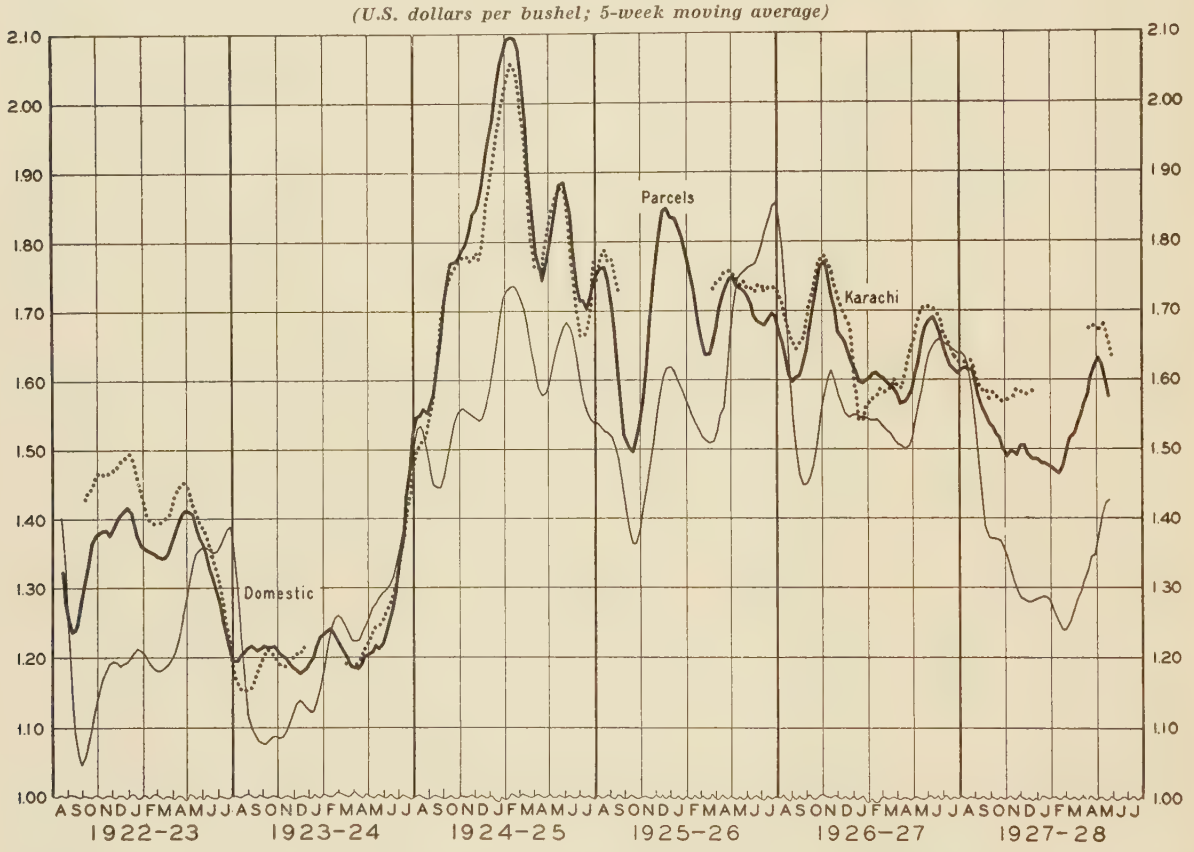
Finally, Chart 9 shows parcels prices in comparison with the prices of Indian (Choice White Karachi) wheat at Liverpool and British domestic wheat.

When the Indian crop and exports are large, as in the crop years 1922–23 to 1924–25, Karachi wheat tends to sell at a discount. In 1922–23, however, Karachi wheat sold at a premium in spite of a large Indian crop. This was due in part to the effect of a very short crop in India in 1921, in part to the relative abundance and cheapness of normally high-priced Canadian wheat. With moderate crops and small exports, as in the crop years 1925–26 to 1927–28, Karachi wheat tends to sell at a premium. The general movement of parcels and Karachi wheat prices is similar, though there are naturally some deviations arising from the fact that Indian wheat reaches the United Kingdom only in small quantity in some periods.

British domestic wheat prices follow the movement of import wheat prices only roughly. There appears to be a marked seasonal upswing in domestic wheat prices

CHART 9.—BRITISH PARCELS PRICES AND PRICES OF CHOICE WHITE KARACHI WHEAT AT LIVERPOOL AND OF BRITISH DOMESTIC WHEAT, WEEKLY FROM AUGUST 1922*

(U.S. dollars per bushel; 5-week moving average)


2.10
2.00
1.90
1.80
1.70
1.60
1.50
1.40
1.30
1.20
1.10
1.00
Parcels
Karachi
Domestic
A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1922-23
1923-24
1924-25
1925-26
1926-27
1927-28

* Karachi prices derived from weekly (Friday) quotations in *International Crop Report and Agricultural Statistics*, supplemented from April 17, 1928, by weekly (Tuesday) quotations in *Corn Trade News;* British domestic prices are weekly average *Gazette* prices as given in the *Economist.*

toward the end of the crop year as supplies near exhaustion. As a rule, domestic wheat commands substantially lower prices than import wheats. At times domestic wheat, though certainly not so good as the average import wheat in quality, may sell for higher prices; this is perhaps due at least in part to the fact that British wheat is preferred for poultry feed. Variations in the quality of the British crop apparently give rise to larger discounts in some years than in others. Thus the poor-quality crops of 1924 and 1927 gave rise to persistently heavy discounts. The large discount in 1922–23, on the other hand, was perhaps due chiefly to the large size of the domestic crop rather than to its quality.

The foregoing price comparisons are of course by no means exhaustive. They are intended to show that, once a usable series representative of the range of British import or world wheat prices is obtained, short-time comparisons of specific price series in some detail can be attempted with more precision and clarity than without such a representative series. The series of parcels prices seems to provide a workable medium not only for this purpose, but for comparisons of wheat price movements in different markets of the world over short periods of time. For these purposes, at least, it seems more serviceable than any other available series; and it is clearly a significant world wheat price series.

This issue is the work of M. K. Bennett, with the advice of Joseph S. Davis and the aid of the statistical staff of the Institute

APPENDIX

TABLE I.—WEEKLY AVERAGES AND RANGES OF BRITISH PARCELS PRICES FROM AUGUST 1922*

Week ending	Shillings and pence per quarter			Equivalent dollars per bushel			Week ending	Shillings and pence per quarter			Equivalent dollars per bushel		
	High	Low	Average	High	Low	Average		High	Low	Average	High	Low	Average
1922							1923						
Aug. 5..	56 6	46 3	51 8⅞	1.57	1.28	1.44	Aug. 4..	44 6	37 3	41 6⅜	1.27	1.06	1.19
12..	55 9	45 6	49 6	1.55	1.27	1.38	11..	44 3	38 0	41 5⅜	1.26	1.08	1.18
19..	52 6	37 0	46 7⅞	1.46	1.04	1.30	18..	44 9	36 4½	41 8⅜	1.28	1.04	1.19
26..	51 0	41 0	45 1¼	1.43	1.15	1.26	25..	46 10½	39 6	43 0	1.33	1.12	1.22
Sept. 2..	50 6	40 0	44 7	1.41	1.12	1.24	Sept. 1..	47 1½	37 3	43 1⅝	1.34	1.06	1.23
9..	50 6	37 4½	43 5⅜	1.41	1.04	1.21	8..	47 7½	36 9	43 3⅛	1.34	1.04	1.22
16..	50 0	39 0	44 2⅞	1.39	1.08	1.23	15..	47 4½	39 1½	42 6¼	1.35	1.11	1.21
23..	49 9	33 1½	45 4⅜	1.37	.92	1.26	22..	46 9	37 9	42 4⅞	1.33	1.07	1.20
30..	51 0	42 0	46 2	1.39	1.16	1.27	29..	47 0	37 3	42 6⅛	1.34	1.06	1.21
Oct. 7..	51 6	39 9	47 0	1.42	1.10	1.30	Oct. 6..	45 0	38 6	42 9½	1.28	1.09	1.22
14..	53 0	45 7½	49 1¼	1.47	1.26	1.36	13..	46 0	41 4½	43 5	1.31	1.18	1.24
21..	55 0	45 9	49 9⅝	1.54	1.27	1.39	20..	45 1½	40 7½	43 1⅜	1.28	1.15	1.22
28..	52 0	46 0	49 3⅜	1.45	1.28	1.37	27..	45 0	33 6	42 9½	1.27	.94	1.20
Nov. 4..	55 4½	44 6	50 5⅜	1.54	1.24	1.40	Nov. 3..	45 10½	40 7½	43 5⅛	1.28	1.13	1.22
11..	52 0	46 6	48 6⅝	1.45	1.30	1.35	10..	47 0	39 4½	43 10	1.31	1.09	1.21
18..	54 6	44 9	49 6½	1.52	1.25	1.38	17..	46 9	39 10½	44 0⅜	1.26	1.08	1.20
25..	53 3	47 0	50 0¼	1.49	1.32	1.40	24..	45 7½	39 6	43 10⅞	1.23	1.08	1.19
Dec. 2..	53 0	34 6	48 7⅞	1.50	.98	1.38	Dec. 1..	45 9	38 3	43 3⅜	1.26	1.04	1.18
9..	51 4½	45 9	47 9	1.47	1.31	1.36	8..	45 0	40 7½	43 3⅞	1.23	1.10	1.18
16..	51 0	46 0	48 5¼	1.47	1.33	1.40	15..	45 3	38 1½	43 1½	1.23	1.04	1.18
23..	53 0	46 9	49 4⅝	1.54	1.36	1.43	22..	46 0	38 7½	43 1⅝	1.26	1.06	1.18
30..	53 3	46 6	49 9½	1.54	1.35	1.44	29..	44 6	40 9	43 5⅝	1.21	1.11	1.18
1923							1924						
Jan. 6..	53 0	44 7½	48 4	1.54	1.30	1.40	Jan. 5..	45 6	41 6	44 3¾	1.23	1.11	1.19
13..	52 9	44 4½	47 8⅝	1.54	1.29	1.39	12..	47 4½	36 6	44 11⅞	1.26	.98	1.20
20..	52 0	43 3	47 4¼	1.52	1.26	1.38	19..	48 0	37 0	45 11⅞	1.28	.98	1.22
27..	49 6	44 9	46 5¾	1.44	1.30	1.35	26..	48 3	37 3	45 11½	1.28	.98	1.21
Feb. 3..	47 6	43 0	46 0	1.39	1.24	1.34	Feb. 2..	49 0	44 0	46 9⅛	1.31	1.17	1.25
10..	49 9	43 6	46 2⅛	1.46	1.27	1.35	9..	50 0	43 0	46 8⅜	1.35	1.16	1.26
17..	49 6	43 9	46 9⅜	1.45	1.28	1.37	16..	50 6	41 6	45 9¾	1.36	1.12	1.23
24..	49 3	43 3	46 1½	1.45	1.27	1.36	23..	48 3	42 0	45 8¼	1.30	1.13	1.23
Mar. 3..	47 9	42 9	45 8⅞	1.40	1.26	1.34	Mar. 1..	49 6	42 0	45 11½	1.33	1.13	1.24
10..	47 9	42 0	45 1	1.40	1.23	1.32	8..	48 4½	41 6	45 8½	1.30	1.11	1.22
17..	48 1½	43 6	45 3⅜	1.42	1.28	1.33	15..	47 6	41 6	44 10⅞	1.28	1.11	1.20
24..	49 6	43 9	46 3¾	1.45	1.28	1.36	22..	47 3	41 10½	44 5⅞	1.26	1.13	1.19
31..	48 3	45 0	46 6½	1.41	1.32	1.36	29..	46 7½	40 9	44 1	1.25	1.10	1.18
Apr. 7..	51 0	44 3	46 10⅛	1.49	1.29	1.37	Apr. 5..	46 3	41 3	43 9¾	1.24	1.11	1.18
14..	52 3	45 0	48 1	1.52	1.31	1.40	12..	46 6	41 3	43 6½	1.26	1.12	1.18
21..	52 6	46 9	48 7⅝	1.53	1.36	1.42	19..	46 6	41 6	44 1	1.26	1.13	1.20
28..	52 6	47 6	49 5	1.52	1.38	1.43	26..	46 6	41 0	43 3⅞	1.28	1.12	1.19
May 5..	52 3	47 10½	49 0¼	1.51	1.38	1.42	May 3..	47 3	41 3	44 2¾	1.30	1.13	1.21
12..	49 9	47 1½	48 3	1.44	1.36	1.39	10..	47 9	41 9	44 10⅝	1.31	1.14	1.23
19..	50 6	46 6	48 1⅛	1.46	1.34	1.39	17..	48 0	40 10½	44 0½	1.31	1.12	1.20
26..	50 0	46 0	48 1	1.45	1.33	1.39	24..	48 0	41 10½	44 8⅜	1.31	1.14	1.22
June 2..	51 6	44 9	46 10¼	1.49	1.29	1.36	31..	48 0	41 9	45 5¾	1.30	1.13	1.23
9..	50 0	42 6	46 1⅝	1.44	1.23	1.33	June 7..	47 6	42 6	44 7⅝	1.28	1.15	1.20
16..	49 0	42 0	46 7½	1.41	1.21	1.34	14..	50 0	41 3	46 0⅛	1.35	1.11	1.24
23..	49 0	42 6	45 8¾	1.41	1.23	1.32	21..	50 3	44 9	47 5⅞	1.36	1.21	1.28
30..	49 9	41 6	44 11⅛	1.43	1.19	1.29	28..	50 9	45 4½	48 2¾	1.37	1.23	1.30
July 7..	52 0	41 9	45 0⅛	1.48	1.19	1.28	July 5..	51 9	45 6	48 10½	1.40	1.23	1.32
14..	47 6	40 3	43 8½	1.35	1.16	1.25	12..	51 9	46 0	49 1	1.42	1.25	1.33
21..	46 10½	39 6	42 8¼	1.35	1.13	1.23	19..	56 0	48 6	52 1½	1.53	1.33	1.42
28..	46 0	37 0	41 8	1.32	1.06	1.20	26..	59 9	50 3	54 5	1.64	1.38	1.50

* Derived from daily data, for 1922–23 from Broomhall's *Corn Trade News*, for subsequent years from *London Grain, Seed and Oil Reporter*. See text (pp. 290–91, 293) for methods of calculating weekly averages and converting to U.S. currency. Ranges show the high and low sales of individual parcels in each week.

TABLE I.—WEEKLY AVERAGES AND RANGES OF BRITISH PARCELS PRICES FROM AUGUST 1922—*Continued*

Week ending	Shillings and pence per quarter			Equivalent dollars per bushel			Week ending	Shillings and pence per quarter			Equivalent dollars per bushel		
	High	Low	Average	High	Low	Average		High	Low	Average	High	Low	Average
1924							1925						
Aug. 2..	62 0	53 0	57 7¼	1.71	1.46	1.59	Aug. 1..	59 9	51 0	55 9⅜	1.82	1.55	1.70
9..	61 0	52 3	55 5⅞	1.70	1.48	1.56	8..	63 1½	42 0	58 0⅞	1.92	1.28	1.77
16..	58 9	51 3	54 5⅝	1.67	1.46	1.55	15..	63 6	36 3	58 5¾	1.93	1.10	1.78
23..	59 9	51 1½	55 1	1.69	1.44	1.55	22..	64 3	49 9	58 10¾	1.95	1.51	1.79
30..	57 6	46 3	53 6⅜	1.61	1.30	1.50	29..	64 6	45 0	58 2½	1.96	1.37	1.77
Sept. 6..	60 6	48 1½	58 4¼	1.69	1.35	1.63	Sept. 5..	64 6	50 6	56 0½	1.96	1.54	1.70
13..	59 6	50 10½	55 3⅛	1.66	1.41	1.54	12..	64 3¾	47 0	55 1¼	1.96	1.43	1.68
20..	60 9	53 3	57 1⅝	1.69	1.48	1.59	19..	61 9	45 4½	52 8⅜	1.88	1.38	1.60
27..	63 6	44 10½	58 1½	1.77	1.25	1.62	26..	61 3	47 6	51 4⅞	1.86	1.44	1.56
Oct. 4..	67 0	54 9	61 1¼	1.87	1.52	1.70	Oct. 3..	51 9	44 6	48 3⅞	1.57	1.35	1.47
11..	70 3	60 0	64 11⅜	1.97	1.67	1.82	10..	51 6	44 4½	48 4⅜	1.57	1.35	1.47
18..	69 6	58 6	64 1¾	1.95	1.64	1.80	17..	55 6	45 7½	48 11¾	1.69	1.39	1.49
25..	67 10½	53 0	63 5⅜	1.90	1.49	1.78	24..	52 6	46 3	49 8½	1.60	1.41	1.51
Nov. 1..	66 0	55 6	61 7½	1.86	1.57	1.74	31..	55 6	46 5¼	50 7⅛	1.69	1.41	1.54
8..	66 3½	55 6	59 11¼	1.90	1.58	1.71	Nov. 7..	56 6	47 0	51 3¾	1.72	1.43	1.56
15..	69 6	59 9	63 11⅝	2.01	1.72	1.85	14..	55 6	48 0	52 0⅞	1.69	1.46	1.58
22..	69 4½	57 9	63 8⅝	2.00	1.67	1.84	21..	58 0	49 9	54 1⅛	1.76	1.51	1.64
29..	68 4½	58 6	63 6⅜	1.98	1.70	1.84	28..	62 0	52 3	56 8⅛	1.89	1.59	1.72
Dec. 6..	67 6¾	57 9	62 6⅛	1.96	1.68	1.82	Dec. 5..	64 0	55 0	60 8⅜	1.95	1.67	1.85
13..	68 4½	56 3	62 10¼	2.01	1.65	1.84	12..	65 4½	57 0	62 2⅜	1.99	1.73	1.89
20..	70 0	58 10½	64 1⅜	2.05	1.73	1.88	19..	62 6	53 0	59 6½	1.90	1.61	1.81
27..	71 0¾	60 3	64 7⅜	2.09	1.77	1.90	26..	62 6	52 0	59 2½	1.90	1.58	1.80
1925							1926						
Jan. 3..	73 3	60 9	66 8¼	2.18	1.80	1.98	Jan. 2..	64 3	55 0	61 2⅝	1.95	1.67	1.86
10..	72 7½	60 6	67 3⅜	2.16	1.80	2.01	9..	64 8¼	53 9¾	61 5⅜	1.97	1.64	1.87
17..	73 1½	60 9	66 5	2.18	1.81	1.98	16..	63 6	55 0	60 1¾	1.93	1.67	1.83
24..	75 5½	61 3	68 0⅛	2.26	1.83	2.04	23..	62 1½	52 9	59 0⅜	1.89	1.60	1.80
31..	79 9	63 6	70 2¼	2.39	1.90	2.10	30..	62 1½	51 0	57 6	1.89	1.55	1.75
Feb. 7..	78 0	63 9	71 10	2.33	1.90	2.15	Feb. 6..	63 4½	51 0	59 0⅞	1.93	1.55	1.80
14..	76 0	62 0	69 8⅞	2.27	1.85	2.08	13..	62 5¼	50 9	57 8⅛	1.90	1.54	1.75
21..	78 1½	63 1½	70 2¼	2.33	1.88	2.09	20..	59 1½	50 1½	56 8⅞	1.80	1.52	1.73
28..	76 6	61 4½	69 0⅛	2.28	1.82	2.05	27..	59 0	50 0	55 3⅞	1.80	1.52	1.68
Mar. 7..	77 0	59 10½	70 2⅞	2.29	1.78	2.09	Mar. 6..	58 0	48 6	53 6¾	1.76	1.48	1.63
14..	74 0	62 0	69 3¼	2.20	1.86	2.07	13..	58 0	47 6	52 7⅜	1.76	1.44	1.60
21..	66 3	51 6	61 3	1.98	1.54	1.83	20..	59 9	46 6	53 7½	1.82	1.41	1.63
28..	66 0	58 9	62 7¼	1.97	1.76	1.87	27..	58 9	47 7½	54 0½	1.79	1.45	1.64
Apr. 4..	64 1½	51 3	57 9⅜	1.92	1.53	1.73	Apr. 3..	59 3	49 6	55 2½	1.80	1.51	1.68
11..	60 4½	54 0	57 6⅝	1.81	1.62	1.72	10..	59 9	50 3	55 11½	1.82	1.53	1.70
18..	64 3	47 0	58 8¼	1.92	1.41	1.76	17..	61 6	50 3	56 7¼	1.87	1.53	1.72
25..	63 0	54 4½	58 8⅞	1.89	1.63	1.76	24..	63 6	52 6	58 5¾	1.93	1.60	1.78
May 2..	62 0	53 3	58 0⅝	1.88	1.61	1.76	May 1..	61 7½	51 3	57 3¼	1.87	1.56	1.74
9..	66 3	48 7½	60 5¼	2.01	1.47	1.83	8..	59 9	52 0	57 3	1.82	1.58	1.74
16..	65 0	46 9	60 8¼	1.97	1.42	1.84	15..	61 6	50 6	57 8⅞	1.87	1.54	1.76
23..	67 4½	55 7½	62 6⅜	2.05	1.69	1.90	22..	62 1½	50 7½	56 10¼	1.89	1.54	1.73
30..	68 3	56 4½	63 7⅛	2.07	1.71	1.93	29..	60 9	50 6	56 6¾	1.85	1.54	1.72
June 6..	66 3	55 10½	62 8⅜	2.02	1.70	1.91	June 5..	59 10½	51 0	56 3⅝	1.82	1.55	1.71
13..	66 3	44 1½	60 9¾	2.02	1.34	1.85	12..	60 1½	46 0	56 7½	1.83	1.40	1.72
20..	63 3	51 9	56 11	1.92	1.57	1.73	19..	70 6	51 4½	56 8¼	2.14	1.56	1.72
27..	62 10½	52 7½	57 11⅜	1.91	1.60	1.76	26..	59 4½	50 9	54 11¾	1.81	1.54	1.67
July 4..	60 3	39 9	54 10	1.83	1.21	1.67	July 3..	58 7½	47 3	53 7⅞	1.78	1.44	1.63
11..	59 4½	45 9	54 8½	1.81	1.39	1.66	10..	59 9	50 0	54 9⅝	1.82	1.52	1.67
18..	62 0	48 6	57 3⅜	1.89	1.48	1.74	17..	59 9	51 0	56 2¼	1.82	1.55	1.71
25..	62 9	51 3	57 1⅝	1.91	1.56	1.74	24..	60 6	50 0	56 2⅞	1.84	1.52	1.71
							31..	60 0	50 0	56 1⅜	1.82	1.52	1.71

TABLE I.—WEEKLY AVERAGES AND RANGES OF BRITISH PARCELS PRICES FROM AUGUST 1922—*Concluded*

Week ending	Shillings and pence per quarter			Equivalent dollars per bushel			Week ending	Shillings and pence per quarter			Equivalent dollars per bushel		
	High	Low	Average	High	Low	Average		High	Low	Average	High	Low	Average
1926							1927						
Aug. 7..	59 4½	49 6	55 3	1.81	1.51	1.68	Aug. 6..	58 0	50 9	52 8⅞	1.76	1.54	1.60
14..	58 1½	48 6	54 2¼	1.77	1.48	1.65	13..	58 9	47 9	53 7⅜	1.79	1.45	1.63
21..	58 3	47 10½	52 11¾	1.77	1.46	1.61	20..	58 7½	45 6	53 4¾	1.78	1.38	1.62
28..	58 1½	47 9	53 6⅞	1.77	1.45	1.63	27..	58 7½	48 0	53 3⅜	1.78	1.46	1.62
Sept. 4..	59 0	48 4½	52 0½	1.80	1.47	1.58	Sept. 3..	57 3	47 0	52 1¾	1.74	1.43	1.59
11..	56 7½	48 0	51 2¼	1.72	1.46	1.56	10..	56 9	48 3	52 7¾	1.73	1.47	1.60
18..	57 0	48 9	52 10¼	1.73	1.48	1.61	17..	56 0	45 6	50 7½	1.70	1.38	1.54
25..	56 9	51 3	53 10⅛	1.73	1.56	1.64	24..	56 0	46 0	50 4⅜	1.70	1.40	1.53
Oct. 2..	56 6	50 4½	53 8½	1.72	1.53	1.63	Oct. 1..	55 6	44 4½	50 3	1.69	1.35	1.53
9..	56 6	50 3	54 1¾	1.72	1.53	1.65	8..	54 3	43 9	50 6½	1.65	1.33	1.54
16..	57 9	50 9	55 0⅞	1.76	1.54	1.68	15..	57 3	39 7½	50 10¾	1.74	1.20	1.55
23..	63 3	52 10½	58 1⅝	1.92	1.61	1.77	22..	58 7½	37 6	49 6⅞	1.78	1.14	1.51
30..	64 6	55 0	59 11⅝	1.96	1.67	1.82	29..	55 0	37 3	48 10¾	1.67	1.13	1.49
Nov. 6..	62 3	53 9	58 7⅜	1.89	1.64	1.78	Nov. 5..	55 6	42 3	48 11⅜	1.69	1.28	1.49
13..	61 4½	54 3	58 1⅝	1.87	1.65	1.77	12..	56 0	43 9	48 0⅝	1.70	1.33	1.46
20..	59 6	51 9	56 3⅛	1.81	1.57	1.71	19..	58 6	38 10½	49 10¾	1.78	1.18	1.52
27..	58 6	51 3	55 4	1.78	1.56	1.68	26..	58 0	41 6	50 5¼	1.76	1.26	1.53
Dec. 4..	58 0	49 3	54 10⅝	1.76	1.50	1.67	Dec. 3..	57 3	39 1½	48 9¾	1.74	1.19	1.48
11..	59 0	45 0	55 2¾	1.80	1.37	1.68	10..	54 3	39 6	48 4½	1.65	1.20	1.47
18..	58 3	49 0	52 6⅜	1.77	1.49	1.60	17..	57 0	41 0	49 9⅜	1.73	1.25	1.51
25..	58 0	49 7½	54 8¼	1.76	1.51	1.66	24..	57 0	45 6	50 0	1.73	1.38	1.52
1927							31..	51 6	41 9	48 6⅝	1.57	1.27	1.48
Jan. 1..	56 0	49 0	54 0½	1.70	1.49	1.64	1928						
8..	55 6	39 0	52 4⅞	1.69	1.19	1.59	Jan. 7..	55 4½	38 6	47 9⅜	1.68	1.17	1.45
15..	55 3	44 1½	52 1	1.68	1.34	1.58	14..	55 0	41 0	48 4⅛	1.67	1.25	1.47
22..	56 0	39 9	51 7⅝	1.70	1.21	1.57	21..	55 1½	39 10½	49 6⅜	1.68	1.21	1.51
29..	56 9	41 6	52 6¼	1.73	1.26	1.60	28..	51 0	47 4½	49 2⅝	1.55	1.44	1.50
Feb. 5..	57 0	41 3	53 4⅛	1.73	1.26	1.62	Feb. 4..	51 10½	43 7½	48 4⅝	1.58	1.33	1.47
12..	57 6	41 0	53 2⅞	1.75	1.25	1.62	11..	55 6	42 0	47 2⅞	1.69	1.28	1.44
19..	58 0	40 0	52 5⅛	1.76	1.22	1.60	18..	55 0	43 0	47 10	1.67	1.31	1.46
26..	57 6	45 3	52 9⅛	1.75	1.38	1.60	25..	53 1½	41 6	48 10	1.62	1.26	1.48
Mar. 5..	57 7½	45 3	52 6¼	1.75	1.38	1.60	Mar. 3..	52 10½	41 7½	48 6⅜	1.61	1.27	1.48
12..	59 0	40 9	52 7½	1.80	1.24	1.60	10..	53 10½	43 0	49 8⅝	1.64	1.31	1.51
19..	57 3	44 6	52 11	1.74	1.35	1.61	17..	52 10½	46 6	50 9½	1.61	1.41	1.54
26..	57 1½	40 3	51 5⅞	1.74	1.22	1.57	24..	55 6	42 9	50 10¼	1.69	1.30	1.55
Apr. 2..	57 4½	48 0	51 10	1.74	1.46	1.58	31..	53 0	43 3	49 11⅜	1.61	1.32	1.52
9..	56 9	49 0	51 11⅝	1.73	1.49	1.58	Apr. 7..	53 3	45 1½	50 9⅝	1.62	1.37	1.54
16..	56 6	35 9	50 10⅛	1.72	1.09	1.55	14..	55 10½	46 0	51 11⅝	1.70	1.40	1.58
23..	57 0	39 9	51 2¼	1.73	1.21	1.56	21..	56 9	47 6	53 6⅞	1.73	1.44	1.63
30..	56 9	37 9	51 9⅜	1.73	1.15	1.58	28..	57 1½	47 6	53 1⅜	1.74	1.44	1.62
May 7..	57 9	41 9	52 7⅜	1.76	1.27	1.60	May 5..	57 6	47 10½	53 7⅜	1.75	1.46	1.63
14..	58 9	44 0	54 0½	1.79	1.34	1.64	12..	56 4½	51 0	54 0⅝	1.72	1.55	1.64
21..	58 0	47 6	53 11¾	1.76	1.44	1.64	19..	55 4½	45 7½	53 6½	1.68	1.39	1.63
28..	58 3	44 3	54 8⅜	1.77	1.35	1.66	26..	55 4½	47 1½	52 1⅜	1.68	1.43	1.58
June 4..	62 0	53 6	56 9⅞	1.89	1.63	1.73	June 2..	54 6	44 9	49 2⅜	1.66	1.36	1.50
11..	57 3	53 6	55 8	1.74	1.63	1.69	9..	54 9	41 9	49 10⅛	1.66	1.27	1.52
18..	59 1½	52 9	55 8⅞	1.80	1.60	1.70	16..	54 3	43 7½	49 0½	1.65	1.33	1.49
25..	57 4½	45 3	54 8½	1.74	1.38	1.66	23..	53 0	38 4½	47 8⅝	1.61	1.17	1.45
July 2..	59 3	49 4½	53 6½	1.80	1.50	1.63	30..	51 6	36 0	47 6¼	1.57	1.09	1.45
9..	59 4½	50 9	54 5⅜	1.81	1.54	1.66	July 7..						
16..	58 3	41 9	52 6¼	1.77	1.27	1.60	14..						
23..	55 6	48 3	52 11¼	1.69	1.47	1.61	21..						
30..	59 3	46 6	52 8	1.80	1.41	1.60	28..						

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VOL. IV, NO. 9 AUGUST 1928

EX-EUROPEAN TRADE IN WHEAT AND FLOUR

EX-EUROPEAN imports of wheat and flour are becoming increasingly important. Between 1909–13 and 1921–26, the average annual volume of ex-European trade increased by some 45 million bushels, or 50 to 60 per cent, while European trade increased only about 30 million bushels, or not much more than 5 per cent. Growth of the Asiatic trade accounted for most of the increase in ex-European takings. Further growth is likely: there are few ex-European areas where domestic wheat production shows promise of obviating the need for imports; and per capita consumption of wheat is apparently increasing in most of these countries. Within a decade or so the ex-European trade may amount to as much as a fourth of the international trade, as contrasted with an eighth before the war.

European imports have always consisted chiefly of wheat, ex-European imports chiefly of flour. In the post-war period, the flour trade of ex-Europe was almost as large as that of Europe. But flour tends to become a smaller fraction of the trade in wheat and flour combined, since several important importing countries now protect their domestic milling industries. The United States remains the chief source of ex-European supplies of wheat and flour, but has become relatively less important with the more rapid expansion in the exports of Australia and Canada.

The ex-European demand appears to be rather less elastic than is commonly supposed. Year-to-year variations in the volume of trade have been large in post-war years. They appear to have been due, however, quite as much to fluctuations in the Chinese wheat crop and to a general upward trend of wheat consumption as to variations in wheat prices and concomitant substitution of other cereals for wheat.

STANFORD UNIVERSITY, CALIFORNIA

August 1928

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OF THE

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STANFORD UNIVERSITY, CALIFORNIA

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The Food Research Institute was established at Stanford University in 1921 jointly by the Carnegie Corporation of New York and the Trustees of Leland Stanford Junior University, for research in the production, distribution, and consumption of food.

EX-EUROPEAN TRADE IN WHEAT AND FLOUR

This study treats of the wheat and flour trade of net importing countries outside of Europe, with special reference to its volume before and since the war, the sources of imports, and the outlook for expansion. Some consideration is given to variations in the volume from year to year.

The subject has heretofore received little analysis, chiefly because timely and inclusive statistics are difficult to obtain and because European countries constitute a group of importers so much more important than the non-European. Nevertheless, ex-European trade is by no means unimportant. It has increased substantially since the five years before the Great War. In the post-war years 1921–26 ex-Europe imported, on the average, over 125 million bushels a year; about 17 per cent of the world's net exports of wheat and flour was shipped to ex-European countries; and their takings of flour exports have been almost as large as Europe's. Their demand is accordingly a significant factor in determining world wheat prices. The nature of this demand, the extent and causes of changes in it from year to year, and the trend in different countries and regions, all have a material bearing on the world wheat position and outlook. Moreover, differences among the numerous ex-European countries, in wheat production, consumption, and importation, are of interest in themselves.

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We use the term ex-European importing countries to include, so far as the data permit, all countries lying outside of Europe which have been net importers of wheat and flour combined in any year of the pre-war or post-war periods studied. The pre-war period is defined to include the five calendar years 1909–13 (or the crop years 1909–10 to 1913–14), since data are more readily available for these years than for others and since there seems no good reason to select a different period. The post-war period is usually treated as including the six calendar years 1921–26, occasionally the five crop years 1922–23 to 1926–27.

For convenience we have treated as parts of Europe Iceland, the Azores, and ordinarily the Canary Islands and that part of modern Greece lying in Asia Minor; and Asiatic Russia cannot be treated otherwise since Russian statistics include Asiatic Russia. All other countries outside of Europe are ex-European, but not all, of course, are ex-European net importing countries. The absence of statistical data for some countries—Afghanistan, Thibet, Mongolia, Eastern Turkestan, Arabia, Georgia, Azerbaijan, Turkey in Asia, Abyssinia—does not permit one to determine their status. Several ex-European countries are net exporters, not net importers, of wheat and flour. Morocco, Chile, and Uruguay, as well as Canada, the United States, Argentina, and Australia, are always net exporters; accordingly their imports (though imports of the United States from Canada may be of large volume) do not lie within the scope of this study. Most other ex-European countries for which data are available are consistently net importers, but there are exceptions. Eritrea (an Italian possession in Africa), Persia, Irak, China, and New Zealand have been net importers in some years, net exporters in others; and Algeria, Tunis, and India are usually net exporters, but each has been a net importer in one year of the period studied. In these cases we have included the country in our totals of net imports only in the years in which it was a net importer. The list of ex-European net importing countries does not remain the same from year to year.

A general view of ex-European trade cannot well be obtained either by successive consideration of statistics of over 130 individual countries, or merely by study of summations of the trade of all. Hence we have compiled subtotals showing the trade of each continental group of countries.

Several arbitrary distinctions have been made in this process; Curaçao and Trinidad and Tobago, for example, often regarded as a part of South America, have been treated as parts of Central America. In obtaining totals of exports to continental groupings, it has not always been possible to follow the lines of demarcation employed in grouping statistics of net imports, but the resulting errors seem of small importance.

Out of the detail of this study several salient points emerge. Evidence of several sorts suggests that the volume of ex-European trade increased between the pre-war and post-war periods by 50 to 60 per cent, while European trade increased by some 5 to 6 per cent. In absolute figures, ex-European trade increased about 45 million bushels, European trade about 30 million. But the ex-European flour trade, which constituted about 65 per cent of the total trade in wheat and flour before the war, has not grown so rapidly as the wheat trade. The tendency throughout the world to encourage domestic milling of wheat, by tariff regulations and otherwise, has been effective in ex-Europe as well as Europe. Notable examples among ex-European countries are Japan, Brazil, and South Africa.

The United States was the principal source of ex-European imports both before and after the war. Argentina was next in importance before the war, but after the war was surpassed by Australia and by Canada. The considerable exports from Europe to ex-Europe before the war became negligible thereafter. Ordinarily the movement of wheat and flour from exporting countries is to those importing countries most accessible to them; but special circumstances, such as preferential tariffs and demand for particular types of wheat, may give rise to exceptions. There are few large importing countries of ex-Europe whose trade is monopolized by any single exporting country.

Before the war, South American countries imported more wheat and flour than any other continental group; African and North American countries were next in importance. But the trade of Asiatic countries showed the greatest growth, and this group surpassed others in importance after the war. Of the several groups, only the North American showed a greater increase in flour than in wheat imports. The increase in imports shown by most countries has apparently been due not only to increasing population, but also to increasing per capita consumption of wheat. The evidence suggests the likelihood of further increases except in western Asia and northern Africa, where domestic production of wheat may increase sufficiently to take care of probable increases in consumption.

Variations in the annual volume of ex-European trade have been large chiefly because of variations in the takings of China and Japan. On the whole, annual variations in ex-European trade seem to be explained by fluctuations in the Chinese wheat crops and by the upward trend of consumption as much as by changes in wheat prices and concomitant substitution of other cereals for wheat. Hence the ex-European demand appears to be rather more inelastic than is commonly supposed. On the basis of data and conclusions developed in this study, it seems feasible to forecast ex-European "requirements" or probable takings somewhat more satisfactorily than has hitherto been possible.

I. DATA AND METHODS

Available data on the movement of wheat and flour in ex-European trade are diverse in character, and on inspection show certain discrepancies. Hence some explanation of the data and methods used in the present study is called for. With detailed and accurate statistics of the trade of any one country, it is not difficult to measure and describe that trade. This could readily be done for all countries by groups or subgroups if each country were consistently either a net exporter or a net importer both of wheat and of flour, and if adequately detailed trade statistics (comparably compiled) were available for each. Under such circumstances it would be easy to separate net exporters from net importers, and to reach totals of net exports and net imports which might reasonably be expected to balance on the average over periods of

years, though not, of course, in any particular year because imports are recorded at least several weeks later than exports. These circumstances, however, do not hold; more or less serious deficiencies appear in all types of available data, and it is impossible to reduce the different types to a strictly comparable basis.

Three Types of Data

The data hereafter employed are of three sorts: Broomhall's records of overseas shipments to ex-European destinations, as reported in his *Corn Trade News;* official statistics of net imports of numerous countries as reported in the *Yearbooks* of the International Institute of Agriculture, supplemented in some instances by data directly from official trade reports of particular countries; and official statistics of exports as reported in trade reports of net exporting countries. Net import data are uniformly recorded on the calendar year basis. Broomhall's shipments are for crop years August–July, but can be put approximately on a calendar year basis. Net export data are in most instances compiled either on the calendar year or the crop year (July–June) basis, though Indian exports are on the basis of an April–March crop year, while complete data for the United States cannot be obtained by July–June years in the post-war period.

The most familiar annual summations of ex-European trade hitherto compiled are those of Broomhall. One purpose of this study is to check these totals so far as possible by summations of net imports and of exports. But an altogether accurate check of annual calendar year figures cannot be obtained. Broomhall's data cannot be recomputed to a calendar year basis with precision, since he records only weekly shipments, and a new week is not begun on January 1 of each year. Indian exports by destinations must remain on an April–March year; and United States and Canadian exports in the pre-war period must remain on a July–June year. Yet since India ordinarily ships little wheat in January–March, and there is no occasion to examine annual variations in the total volume of trade during pre-war years, the differences in bases of compilation are not of major significance. Similarly it is impossible to place export data from all exporting countries, by destinations, on an identical crop year basis. Broomhall's data are for an August–July year, though they could be put approximately upon a July–June basis. For official exports, more data can be obtained for July-June years than for August–July years. But Indian exports must remain on an April–March year. Chilean exports appear on a calendar year basis, and can be adjusted only roughly to a crop year basis. And United States exports for post-war crop years are incomplete with respect to detailed record of destinations.

Deficiencies of Data

For other reasons, no single type of data is altogether satisfactory.

Net import statistics are incomplete in two respects: the International Institute gives no figures whatever for certain countries;[1] and for some countries figures are not available for all years. Total net imports would be swelled somewhat if data were available for Thibet, Mongolia, Eastern Turkestan, Hongkong, Wei-hai-wei, Kwantung, Siam, Alaska, Honduras, the Danish West Indies, the Virgin Islands, and several islands of Oceania. These countries and dependencies, with the possible exception of the first three, are clearly net importers of wheat and flour combined. Turkey in Asia, Afghanistan, Armenia, Abysinnia, Georgia, and Azerbaijan, for which data are not available, may be either net importers or net exporters; the facts are not clear. Nevertheless the deficiencies of data cannot be great; they are probably less significant, for example, than the omission of the wheat crops of Asia Minor and China from summations intended to show world wheat production. The fact that import statistics of some countries in some years are lacking has necessitated a few estimates; but these are neither numerous nor notably uncertain. On the whole net import statistics give a more detailed

[1] Since this organization apparently compiles data from all countries able to furnish them, we assume that figures cannot be secured from countries not reporting.

statement of the volume of ex-European trade in wheat and flour than can be secured from any other data; but total net imports for ex-Europe as a whole or for continental subgroups must be regarded as understatements of the facts.

A further difficulty with import data lies in the fact that, unless the labor of compilation is to be excessive, one must employ 1909–13 averages already computed by the International Institute of Agriculture. In some instances this renders pre-war and post-war averages not strictly comparable. Our calculations of post-war averages of total net imports, for countries which shift from a net importing to a net exporting position, involve the averaging of figures applicable only to the years in which the countries in question were net importers; we ignore net exports because it is desirable to reach summations of net imports in particular years. The International Institute pre-war averages, however, are apparently compiled by adding together the net imports of wheat and of flour separately for all years when there were net imports, then subtracting the net exports of wheat and of flour for all years when there were net exports, and finally averaging the difference. Thus China was a net exporter of wheat in each of the five years 1909–13, a net importer of flour in 1911–13, but a net exporter of flour in 1909–10 to an extent which made her a net exporter of wheat and flour combined in these two years. According to the calculations by the methods used by the International Institute, China was a net importer of less than half a million bushels of wheat and flour combined for the period 1909–13, whereas according to the alternative method she was a net importer of 1.9 million bushels. But instances of this sort are too few to make appreciable differences in pre-war averages, and for convenience we have employed the readily available figures of the International Institute. The number of ex-European countries for which 1909–13 averages of imports are available much exceeds the number for which annual data can be secured in the *International Yearbooks of Agricultural Statistics.*

Except for measurement of the total volume of trade and for analysis of annual fluctuations, we have made no use of Broomhall's data. Shipments are at best only preliminary approximations to actual exports; they are apparently secured through official channels, but are not corrected and revised to accord with final official statements. Shipments do not include all exports made by rail or river; this, however, is unimportant with respect to ex-European trade since little wheat moves overland. Furthermore, shipments from particular exporting countries to particular ex-European destinations are not given in detail; and adequate separation of total annual shipments by destination is not feasible. Broomhall groups together, for example, shipments to the East Indies, the West Indies, Central America, and Venezuela. Finally, no distinction is made between shipments of wheat and shipments of flour. Partly in order to secure a check upon the accuracy of Broomhall's data, it has seemed preferable to analyze available official statistics of exporting countries.

The principal exporters of wheat and flour to non-European destinations, both before and after the war, have been the United States, Canada, Argentina, Australia, India, and Chile. Nevertheless ex-European countries draw some of their supplies from other sources. Uruguay always exports to Brazil. Some European net importing countries, notably Great Britain, France, Germany, and Italy, export flour to their dependencies outside of Europe, and to other countries. Before the war, Roumania, Hungary, Bulgaria, and Russia exported wheat and flour to Egypt and other ex-European countries, though this movement was apparently negligible in post-war years. Eritrea, New Zealand, Mesopotamia, and China have been net exporters of wheat and flour (combined) to ex-Europe in some years.

In general it has seemed desirable to attempt summations, by countries of destination, only of the exports of the first six countries named, though we have included such large items as the exports of China to ex-Europe in 1921 and of Australia to India in 1922. Thus our totals of exports to ex-Europe destinations must be somewhat too low. A further cause of understatement lies in the fact that exports of India and

Australia "to orders" have not been included, though some of these may have reached ex-European destinations.[1] Again, it has been impossible to determine when certain small exports designated "to other countries" have passed to Europe or to ex-Europe. Thus both import and export data result in understatements of the volume of ex-European trade; and, since Broomhall's data yield figures lower than import and export data, these too understate the volume. Discrepancies between the several sorts of data cannot be reconciled satisfactorily in all instances. In general, however, the broad facts seem to be supported by each type of evidence; and these facts are of sufficient interest to warrant neglect of minor contradictions and uncertainties.

Trade in Wheat and Trade in Flour

An ex-European net importing country is a country which showed a surplus of imports over exports of wheat and flour *combined*. Net import statistics ordinarily show, for each country, the amount of wheat imported, the amount of wheat exported, the amount of flour imported, and the amount of flour exported. Some countries in some years are net exporters of wheat, net importers of flour, and net importers of the two combined; or net importers of wheat, net exporters of flour, and again net importers of wheat and flour combined. Thus China in 1909–13 was a net exporter of 3.6 million bushels of wheat annually, a net importer of 3.9 million bushels of flour as wheat, and hence a net importer of wheat and flour combined of .3 million bushels. Japan in 1926 was a net importer of 25.8 million bushels of wheat, a net exporter of 4.9 million bushels of flour as wheat, and hence a net importer of 20.9 million bushels of wheat and flour combined. The fact that such instances occur gives rise to some difficulty in separating total ex-European net imports of wheat and flour combined, as we have computed these totals, into wheat on the one hand and flour on the other.

We have added together the combined wheat and flour totals for each country, because this study deals chiefly with the total wheat and flour trade. But in order to show the relative importance of ex-European flour trade, we have obtained each country's net import of flour alone. The sum of ex-European net imports of flour subtracted from the sum of net imports of wheat and flour combined will not yield the same figure for net imports of wheat as would be obtained by adding each country's net import of wheat alone.[2] This difficulty, however, is unimportant in connection with statistics of exports to ex-Europe.

II. THE TOTAL VOLUME OF TRADE

Students of the world wheat situation are accustomed, in the course of analyses designed to throw light upon the probable level of world wheat prices during an oncoming crop year, to set estimates of world wheat export surpluses against estimates of world wheat import "requirements." When the margin between export surpluses and import requirements is unusually large, prices may be expected to prove relatively low; and conversely. This approach to the problem of forecasting prices is far from perfect, especially since it has often involved confusion between what may be called "necessary" or "customary" import requirements and the actual shipments or exports which are recorded after the price situation has had its effect upon the movement of wheat and flour in international trade. Nevertheless greater precision in measuring probable "customary" import requirements and probable export surpluses, and hence the size of the margin

[1] Large shipments are made from Argentina to orders, but these shipments presumably go almost entirely to Europe.

[2] Suppose, for example, that country A was a net exporter of 5 million bushels of wheat, and a net importer of 10 million bushels of flour as wheat; country B was a net importer of 10 million bushels of wheat and 10 million bushels of flour as wheat; and country C was a net importer of 20 million bushels of wheat but a net exporter of 8 million bushels of flour as wheat. By our method, total net imports of flour were 20 million bushels, and total net imports of wheat were 30 million bushels; or 50 million bushels in all. But if each country's net position is taken separately, then total net imports were (10−5) + (10+10) + (20−8), or 37 million bushels.

between the two, would contribute somewhat to the accuracy of price forecasting. More needs to be known of trends in production and utilization of wheat in all countries if export surpluses and import requirements are to be measured with greater approach to precision.

The demand for wheat in non-European countries is necessarily a part of the world demand or " requirement." Trade statistics seem to provide the best approach to a study of this ex-European demand. It is desirable to ascertain what countries import wheat and from what sources; where there is evidence of increasing or decreasing importation and what are its causes; and how large the total volume of trade has been and promises to be. The general growth of trade between the pre-war and post-war periods is logically the first subject requiring consideration.

Evidence of Increased Volume of Trade

Three different measures of the growth of international trade in wheat and flour as wheat are shown in Table 1, in terms of pre-war and post-war averages. The first series shows net imports of the net importing countries of the world, of Europe, and of ex-Europe, as reported in detail but not in total by the International Institute of Agriculture. The second shows total net exports of the net exporting countries of the world, exports (usually net) known to have been destined to net importing countries of ex-Europe, and a residuum presumably exported to European net importing countries. The third shows Broomhall's data for shipments (chiefly by sea) in total, to Europe, and to ex-Europe.

If data were available for all countries, one would expect world total net exports slightly to exceed world total net imports, partly because some goods are lost in transit, partly because there is ordinarily more incentive to understate or to avoid reporting imports than exports, and partly because, with imports reported some weeks later than exports, annual growth of trade would cause the average annual net exports of a given period to exceed the average annual net imports. But the excess of net exports over net imports shown in Table 1, averaging about 40 million bushels in both the pre-war and post-war periods, unquestionably reflects in addition material incompleteness of data for net importing countries; and the comparison is complicated by other factors mentioned below.

Similarly the total of overseas shipments might be expected to fall below total net exports, first because such shipments do not include much wheat and flour shipped by rail and river, as for example across the Russian frontier to Poland and Germany, or up the Danube or by rail from Hungary to neighboring countries, or from the United States to Mexico; and also because preliminary reports of trade, on which weekly shipments data are necessarily based, usually give smaller and less complete figures than final trade reports. These factors largely account for the fact that total shipments fall substantially below total net exports; and the decrease in the difference, from 61 million bushels in pre-war period to only 48 million in the post-war period, is probably due largely to improvement in the shipments data.

Net export data seem to represent the world volume of trade most accurately, since they are more complete than net import data and, unlike shipments data, are built up from final official reports. The increase of 11.4 per cent shown by net export data is, however, probably too low. The pre-war figure is somewhat too high for comparison with the post-war because some wheat and flour shipped into parts of the present territory of post-war Poland, Czecho-Slovakia, Lithuania, Esthonia, and Latvia were not recorded as exports from any source in pre-war years, while they are so recorded in post-war years. Changes in boundaries of eastern European countries present the chief difficulty in attempting to compare pre-war and post-war volumes of international trade in wheat and flour. They have resulted in an increase of the list of net importing countries, while cutting down the territory of Russia, Hungary, and Bulgaria, and increasing the territory of Roumania and Jugo-Slavia; and adjustments of pre-war trade statistics to a basis comparable with the post-war are not at present feasible. Moreover, New Zealand was a net exporting country in the pre-war

period, but a net importing country (on the average) in the post-war period; but her net exports are not included in our figures. The real increase in the total volume of trade as shown by net export data has probably been nearer to 13 than to 11.4 per cent.

If, as seems reasonable to suppose, Broomhall's service has gained in efficiency, especially in recent years, the shipments figures were perhaps less complete for the pre-war than for the post-war period, and the percentage increase in the total volume of trade as shown by these data may be too large. Moreover, average annual shipments in post-war years are too large for comparison with pre-war shipments or post-war net exports of net exporting countries, because the post-war shipments figure includes 14.4 million bushels shipped from Germany (a net importer) chiefly to European net importing countries in 1925–26.

TABLE 1.—AVERAGE ANNUAL NET IMPORTS, NET EXPORTS, AND SHIPMENTS OF WHEAT (INCLUDING FLOUR AS WHEAT): TOTAL, TO EUROPE, AND TO EX-EUROPE, 1909–13 AND 1921–26*

(Million bushels)

	Total			Europe			Ex-Europe		
	Net imports of	Net exports to	Broomhall's shipments	Net imports of	Net exports to	Broomhall's shipments	Net imports of	Net exports to	Broomhall's shipments
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1909–13 average.....	625[a]	665[b]	604[d]	545[e]	585[g]	526[d]	80[h]	80[j]	78[d]
1921–26 average.....	702[a]	741[c]	693[d]	575[f]	615[g]	588[d]	127[i]	126[k]	105[d]
Absolute increase.....	77	76	89	30	30	62	47	46	27
Percentage increase...	12.3	11.4	14.6	5.5	5.1	11.8	58.8	57.5	34.6

* Except as stated in following notes, figures are summarized from data in *International Yearbooks of Agricultural Statistics* and Broomhall's *Corn Trade News*. Pre-war averages of net imports and net exports compiled from less complete data than post-war averages.

[a] Column 4 plus column 7.

[b] Summations of annual average net exports during 1909–13 from the United States, Canada, Argentina, Australia, India, Chile, Algeria, Morocco, Serbia, Roumania, Hungary, Bulgaria, and Russia. Does not include small reported net exports from New Zealand, Uruguay, and Eritrea, or unreported net exports from Asia Minor.

[c] Six-year average of the sum of annual calendar year net exports from the United States, Canada, Argentina, Australia, India, Chile, Algeria, Morocco, Tunis, Roumania, Hungary, Bulgaria, Jugo-Slavia, and Russia. Includes net exports of China in 1921, and of Albania, Spain, Lithuania, and Poland in years when these countries were small net exporters. Does not include small net exports from New Zealand, Uruguay, Irak, Persia, and Eritrea in any year. India, Tunis, Algeria, and Russia have not been net exporters in every one of the years 1921–26.

[d] Figures for August–July years adjusted to a calendar year basis and averaged. Includes shipments from Australia to India; from various countries to northern African net exporting countries; and 14.4 million bushels from Germany, chiefly to European net importing countries, in 1925–26.

[e] Summation of 1909–13 average net imports of all reporting countries of Europe, plus an allowance for the changed boundaries and list of countries of eastern Europe.

[f] Six-year average of the sum of annual calendar year net imports of all reporting European countries. Includes net imports of Russia in 1921, 1922, and 1925.

[g] Column 2 minus column 8.

[h] Summation of 1909–13 average net imports of all reporting ex-European countries, with a few estimates. No data available for a few countries.

[i] Six-year average of the sum of annual calendar year net imports of all reporting ex-European countries. Includes net imports of India, Algeria, and Tunis in 1922.

[j] Five-year average of the sum of calendar year exports (usually net) of Australia, Argentina, and Chile, of July–June exports of the United States and Canada, and of April–March exports of India by sea to ex-European net importing countries, plus a rough estimate of 7 million bushels presumably exported to ex-European net importing countries from European countries, chiefly Russia and the Danube countries. Does not include exports to ex-Europe from French North Africa, New Zealand, Uruguay, Eritrea, or countries of Asia Minor. Data from official trade reports of the countries mentioned, in part through J. A. Le Clerc, *International Trade in Wheat and Wheat Flour* (U.S. Department of Commerce, Trade Promotion Series No. 10), 1925. Precise distribution of exports to ex-European net importing as distinguished from net exporting countries is not always feasible.

[k] Six-year average of the sum of calendar year exports (usually net) of Australia, Argentina, Canada, the United States, and Chile, and of April–March exports of India by sea, to ex-European net importing countries. Includes exports of Australia to India in 1922, and of China to various countries in 1921. Does not include exports to ex-Europe from western European countries, French North Africa, New Zealand, Uruguay, Eritrea, countries of Asia Minor, Russia, Bulgaria, Jugo-Slavia, or Hungary. Data from official trade statistics of the countries mentioned. Precise distribution not always feasible.

GREATER INCREASE IN EX-EUROPEAN TRADE

The data summarized in Table 1, in spite of their defects, indicate clearly that ex-European trade has increased relatively more than European between the pre-war and post-war periods. According to these data, net imports of non-European countries and net exports to ex-European destinations have increased over 55 per cent, as

contrasted with an increase of less than 6 per cent for Europe. The reasonably close concordance shown by net import and net export statistics seems not to be accidental, though, on account of the absence of adjustments for changes in the boundaries of eastern European countries, the figure for pre-war net exports to Europe seems too high, and the percentage increase too low. Again, total net imports of and net exports to ex-Europe in the pre-war period are slightly too low for comparison with post-war figures on account of the manner in which Chinese annual data are handled for the pre-war period,[1] so that the increase in ex-European trade is slightly exaggerated by both sets of data.

Broomhall's data show an increase of only 35 per cent in shipments to ex-European destinations and an increase in shipments to Europe of nearly 12 per cent. The divergence between this showing and that of the trade statistics is considerable. In the absence of detailed information on the manner in which shipments data are compiled, only tentative explanations of the discrepancies can be suggested. Probably the major explanation is that total shipments and shipments to Europe were farther below the truth in the pre-war period. It is also possible that some wheat and flour which actually went to ex-Europe in the post-war period was recorded as shipped to Europe. Finally, the inclusion of shipments from Germany to other European countries in 1925–26 results in a post-war figure for shipments to Europe slightly too large for comparison with the pre-war figure. Hence the increase of European trade shown by Broomhall's shipments data is presumably too large, the increase of ex-European trade too small.

On the whole one may conclude that European takings of imported wheat and flour combined increased not much more than 5 per cent between the pre-war and the post-war periods, while ex-European trade increased 50 to 60 per cent. If similar rates of increase should continue, annual average net exports to Europe in 1932–37 might be expected to approximate 645–675 million bushels, while net exports to ex-Europe might reach 190–200 million. This would mean that ex-European trade would constitute nearly a fourth of the total world trade, as against about one-sixth in 1921–26 and one-eighth in 1909–13. In so far as growth of trade reflects growth of demand, it seems clear that ex-European demand for wheat and flour has grown more rapidly than European over the past fifteen years, and has increased in relative importance. A continuance of this increase seems of sufficient potential importance to justify an examination of circumstances under which it may occur. This subject, involving consideration of trends in consumption in different countries, is best considered in subsequent sections.

Net import and net export data alike show that general growth of ex-European trade between the pre-war and post-war periods has occurred in each continental group of countries. The increases shown have been as follows, in million bushels:

Net importing countries of	Increase in net imports of	Increase in net exports to
North and Central America	4.7	6.5
South America	5.8	1.9
Asia	35.1	33.5
Africa	0.2	3.3
Oceania	1.5	1.4
Total	47.3	46.6

The more or less substantial discrepancies between the two sorts of data are of minor significance here; even with necessary qualifications it appears that by far the greater part of the general increase in trade has been due to an increase in the trade of Asiatic countries, principally China and Japan.

Volume of Trade in Flour

World trade in wheat of course comprises trade both in wheat grain and in wheat flour. An approximate summary view of the importance of net imports of flour, relative to the combined total may be obtained from Chart 1 and Table 1 (p. 313).[2] The import trade of European countries includes much more wheat grain than flour,

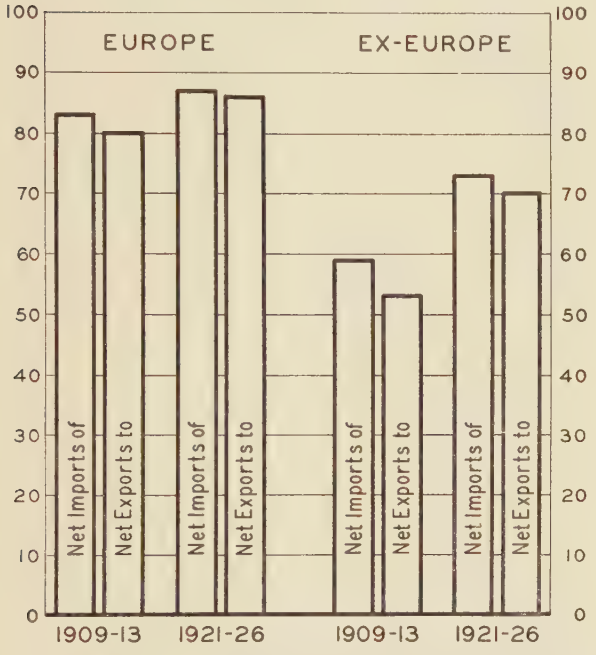
[1] See above, p. 310.

[2] Under the method we have used, as explained above, net imports of wheat grain cannot be obtained precisely by subtracting net flour imports from total net imports.

while the ex-European trade consists quite as much of flour as of wheat. The trade of Europe before the war consisted of flour only to the extent of about 15 per cent; but flour comprised over 65 per cent of the ex-European trade. Between the pre-war and the post-war periods, as appears from the chart, the growth of European trade in flour was small, whereas the ex-European flour trade showed a considerable increase, certainly over 20 per cent.[1] Hence in the post-war period the flour trade of Europe constituted about the same proportion of total trade as before the war. But flour formed a smaller proportion of the ex-European trade; the increase of 14 million bushels as measured by net imports of flour in terms of wheat was less than one-third of the increase of 47 million bushels in net imports of wheat and flour combined.

CHART 1.—PRE-WAR AND POST-WAR ANNUAL VOLUME OF TRADE IN FLOUR (AS WHEAT) OF EUROPE AND EX-EUROPE*

(Million bushels)



* Net imports summarized chiefly from data of International Institute of Agriculture; net exports summarized from official trade statistics, in part as shown in Appendix Tables I–XV. Includes some estimates.

The large proportion of flour in the ex-European wheat trade is due to several facts. Many ex-European countries lie in the tropical zone, do not raise wheat, and hence have no domestic milling industries, so that wheat must be imported already milled. Most of these countries, moreover, are industrially not so far advanced as European countries, and conditions have not been favorable for the rapid development of a milling industry even if wheat was raised domestically. Many have only an inconsiderable animal husbandry, and hence little use for wheat offals. The tendency throughout the world, however, has been to encourage domestic milling of wheat by preferential tariffs and otherwise. As a result net importing countries in many parts of the world tend to import proportionately less flour and more wheat. One may reasonably expect this tendency to operate in the future; ex-European flour imports may continue to expand in absolute quantities, but the proportion of flour in the total wheat trade may be expected to contract as various importing countries further develop their domestic milling industries and import wheat instead of flour. Such changes, however, must occur more slowly where industrialization lags than where it is already far advanced. Consequently ex-European countries will perhaps provide quite as wide a market for flour as European countries, or even a wider one, in years to come; but it will probably prove increasingly difficult to induce importers to purchase flour rather than wheat.

III. SOURCES OF EXPORTS TO EX-EUROPE

A General View

A broad view of the relative importance of the principal sources of wheat and flour exported to ex-European net importing countries is given in Table 2 (p. 316). The United States has been the most important single source of supplies, providing somewhat over one-third of the total. Argentina exported the second largest amount in pre-war years, but in post-war years Australian

[1] Data for intervening years, 1914–20, would show for both Europe and ex-Europe that trade in flour was larger in relation to trade in wheat than was true in either the pre-war or the post-war periods.

and Canadian exports have been larger than the Argentine. Australia, third in importance as a source of ex-European supplies before the war, has ranked second thereafter. India has never been a heavy exporter to ex-Europe, though before the war she shipped nearly as much as Canada. Chile's exports have always been small. The totals also include exports to ex-European countries from China in 1921, but not from New Zealand, Uruguay, Eritrea, and a few exporters still less important in any year. The movement from these minor exporters, except on special occasions, has been small in both periods, and is discussed briefly below.[1]

TABLE 2.—NET EXPORTS OF WHEAT AND FLOUR AS WHEAT TO EX-EUROPEAN NET IMPORTING COUNTRIES FROM PRINCIPAL EXPORTERS, ANNUALLY, 1909–13 AND 1921–26*

(Million bushels)

Year	Total	United States	Canada	Argentina	Australia	India[a]	Chile
1909.....	55.7	26.2[b]	4.0[b]	14.0	8.8	2.0	0.7
1910.....	65.8	30.8[b]	4.7[b]	17.1	10.0	2.1	1.0
1911.....	75.1	37.9[b]	4.7[b]	17.8	11.4	3.0	0.3
1912.....	80.1	41.5[b]	5.4[b]	19.2	9.5	3.6	0.9
1913.....	86.9	37.1[b]	7.0[b]	21.2	16.5	4.4	0.8
Average 1909–13...	79.7[c]	34.7	5.1	17.9	11.3	3.0	0.7
1921.....	104.6[d]	44.4	6.1	14.1	19.7	3.7	1.5
1922.....	112.6[e,f]	48.5[f]	12.8	18.0	30.0[e]	2.5	0.7
1923.....	135.4	64.3	19.8	18.0	29.2	2.9	1.2
1924.....	154.4	54.1	28.6	21.3	39.6	7.4	3.3
1925.....	115.3	36.7	22.5	19.1	34.2	1.5[g]	1.4
1926.....	135.6	51.4	30.6	16.4	33.5	2.7[g]	1.0
Average 1921–26...	126.3	49.9	20.1	17.8	31.0	3.4	1.5

* Summarized from data in official trade reports of the countries mentioned. See Appendix Tables I–XV. Totals and averages include estimates as noted below.

[a] Crop years beginning April of the year indicated.

[b] Crop year beginning July of the year indicated.

[c] Includes estimate of 7 million bushels shipped from Europe.

[d] Includes 15,295 thousand bushels shipped from China to ex-European countries.

[e] Includes 6,960 thousand bushels exported from Australia to India.

[f] Includes 1,606 thousand bushels shipped from United States to Algeria and Tunis.

[g] Estimated.

The table includes in the pre-war average an allowance for shipments of flour from western European countries and of wheat and flour from the Danube countries and Russia. So far as can be ascertained, these exports in pre-war years were little smaller than the combined exports of Canada, India, and Chile to ex-Europe,[2] so that Europe ranked next to Australia as a source of ex-European supplies. The movement from Europe to ex-Europe practically stopped during the war, as Russian and Danubian exports declined or even ceased in some years; and there has been no considerable resumption of this trade. During and immediately after the war, European countries in general had to bend every effort toward securing adequate domestic supplies, and shipping restrictions contributed heavily to cut down the export movement from Europe; hence European countries largely lost ex-European markets to the overseas exporting countries which had maintained or increased their production and exports. Since the war, the recovery of Europe has been slow, and the overseas exporting countries have largely retained their hold on the flour export trade.

The relative growth of ex-European trade among the five leading exporters has apparently depended partly upon relative increases in wheat production and in domestic milling industries, and partly upon the accessibility of ex-European markets where importation has increased most considerably. Australia, Canada, and the United States are all able to ship wheat and/or flour to the Orient because of the operation of established shipping routes; and in each of these countries increases in wheat production and milling output have been pronounced. In Argentina wheat production has increased quite as much as in Australia; but the increase in the exportable surplus of flour has been very small, and costs of shipment to the Orient are relatively high in the absence of established trade routes. Argentine trade even with her best ex-European customer, Brazil, has suffered from competition of the United States and Canada, whose large exportable surpluses

[1] See below, p. 325.

[2] The sum of 1909–13 exports from these regions to ex-European net importing countries is about 5 million bushels. This does not include Russian exports of 6.9 million bushels to "other countries," some of which were probably ex-European net importing countries. We have estimated the exports from Europe to ex-Europe at 7 million bushels.

of flour have found an increasing outlet in that country.[1]

Australian exports to ex-Europe have increased more in absolute terms than the exports of any other country or region. This is due to growth in trade with Egypt, since the Asiatic trade of Australia did not grow more notably than that of the United States or Canada. Before the war, most of the world's exports to Egypt passed across the Mediterranean from several European countries. With the practical cessation of these exports, Australia largely secured the market. The United States, Canada, and Argentina could not compete effectively, chiefly because the established trade route for Australian exports to Europe passed through the Suez Canal, while the routes from Argentina, Canada, and the United States do not. Direct shipments from these countries could be made only at relatively high freight rates unless return cargoes were assured. India, though she ships through the Suez Canal, had too little wheat to spare in several of the post-war years.

The movement of wheat and flour from exporting countries for the most part follows the lines of least resistance. A given exporting country ships wheat to those importing countries lying nearest or most accessible to it; conversely, an importing country obtains supplies (other things being equal) from the source able to ship at the lowest cost of transportation. Chilean wheat moves only to the ex-European importing countries of South America. Argentine wheat moves to South American countries and Africa, not to Asia, North and Central America, or Oceania. Australian wheat moves to Asia, Oceania, and Africa, not to North and Central America or South America. Canadian wheat moves only in small quantities to Oceania, Africa, and South America. Wheat from the United States does not move in large quantities to Oceania (aside from Hawaii), to Africa, or to South America. There are, of course, certain minor exceptions; thus Peru imports wheat from North America and Australia as well as from Chile, and other instances will be noted in subsequent pages.

A single exporting country is usually unable to monopolize the trade of any of the more important ex-European importing countries. Brazil obtains supplies not only from the nearest sources, Argentina and Uruguay, but also from the United States and Canada; the Orient deals largely with both Canada and the United States and with Australia; Egypt obtains her imports from all three of these sources and others. Thus proximity does not, in all instances, yield a decisive advantage; for transportation costs from several exporting countries to a given importing country may run about equal. Between Vancouver and Seattle or Portland, for example, there is no definite or constant shipping advantage in exporting wheat or flour to Japan. Even where there are normally inequalities, special circumstances like preferential duties, or demand for types of wheat and flour not available in the nearest source of export, may cause importing countries to obtain supplies from more distant sources. Thus preferential tariffs or their equivalent give the United States an advantage in Cuba, Hawaii, and the Philippines; and the system of preferential duties in the British Empire favors exports of Canada and Australia to certain British possessions. Furthermore, changes in freight rates and shipping conditions between different years and in wheat and flour prices and available supplies between different exporting countries in a given year presumably give rise to changes in the direction of the export movement.

[1] The following data, showing increases or decreases between the pre-war and post-war periods in average annual exports to ex-Europe, wheat production, and total net exports of flour, are pertinent to this paragraph. Data are from official sources. Total export and wheat production figures are derived from calendar year data; net exports of flour from crop year data.

	Increases in exports to ex-Europe	Increases in wheat production	Increases in net exports of flour
	(Million bushels)	*(Million bushels)*	*(Thousand barrels)*
Australia	20	43	2,852
Canada	15	176	6,229
United States	15	118	3,226
Argentina	0	59	121
India	1	–18	60

Movement from the United States

Exports of wheat and flour combined from the United States to ex-European destinations, by continental groupings, are

shown in Table 3.[1] Exports to North and Central American and to Asiatic countries have comprised around four-fifths of the total in both periods; exports to South American countries make up most of the remaining fifth; countries of Africa and Oceania provide only small markets.

TABLE 3.—UNITED STATES EXPORTS OF WHEAT AND FLOUR AS WHEAT TO EX-EUROPEAN DESTINATIONS, ANNUALLY, 1909–14 AND 1921–26*

(Thousand bushels)

Year	Total	North and Central America	South America	Asia	Africa	Oceania
1909–10.	26,180	14,521	4,398	5,818	792	651
1910–11.	30,777	12,421	5,592	11,435	607	722
1911–12.	37,946	14,548	6,003	16,074	503	818
1912–13.	41,471	15,027	5,982	16,821	2,776	865
1913–14.	37,070	13,480	6,066	15,514	1,096	914
Average 1909–14.	34,689	13,999	5,608	13,133	1,155	794
1921....	44,370	16,669	5,278	18,710	3,031	682
1922....	48,495[a]	16,291	4,233	23,411	3,753[a]	807
1923....	64,315	19,233	4,070	38,190	2,087	735
1924....	54,145	19,596	5,554	26,566	1,624	805
1925....	36,710	16,043	6,253	11,353	2,233	828
1926....	51,428	18,735	11,448	17,118	3,112	1,015
Average 1921–26.	49.910	17,761	6,139	22,558	2,640	812

* Summarized from data in *Foreign Commerce and Navigation of the United States*. Pre-war data are for crop years July–June. For details see Appendix Tables I–III.

[a] Includes exports of 1,606 thousand bushels to Algeria and Tunis.

The distribution of exports is shown in greater detail in Appendix Table I. China and the Japanese Empire have always been by far the most important markets among the Asiatic countries; exports to these two alone were nearly 90 per cent of the Asiatic total in pre-war years and 87 per cent in post-war years. Exports to the Philippines have comprised most of the remaining 10 per cent; exports to Ceylon, the Dutch East Indies, Indo-China, Siam, the Straits Settlements, and others amounted to less than 100 thousand bushels in 1909–13 and only about 550 thousand in 1921–26. Shipments to Asiatic countries naturally pass almost entirely from the Pacific Coast, and consist predominantly of the soft wheat or soft wheat flour grown or milled in that region. The Pacific Coast region may be regarded as almost an isolated wheat-producing region, since rail freight rates are so high as ordinarily to restrict the movement of wheat to easterly markets of the United States; hence outlets for the exportable surplus must usually be sought in Europe, the Orient, the eastern and northern coasts of South America, and parts of Central America.[2] One might therefore expect United States exports to Asiatic countries to vary directly with the wheat crops of Washington, Oregon, and California. If the demand of Asiatic countries remained the same from year to year, they would tend to decrease their imports from the United States in years when wheat crops on the Pacific Coast were small and prices relatively higher than elsewhere, and would then obtain larger supplies from Canada and/or Australia. This would not hold for the Philippines; for the preference accorded to United States products would facilitate the imports of those products in all years except those when Seattle or Portland prices were above (say) Vancouver prices by more than enough to offset the lower charges on United States flour.

That there is some tendency for Pacific Coast crops and United States exports to China and Japan (but not to the Philippines) to vary together is shown by the following data, in million bushels:

Year	Pacific Coast crop[a]	Exports to China, Japan[b]	Exports to Philippines[b]
1909–10	58.7	4.4	1.18
1910–11	61.3	10.4	1.07
1911–12	76.0	14.6	1.45
1912–13	81.0	15.0	1.74
1913–14	73.2	14.4	1.11
1921–22	92.0	23.3	1.57
1922–23	66.3	20.2	2.21
1923–24	104.2	43.9	2.75
1924–25	46.7	7.7	2.77
1925–26	70.6	10.6	2.80
1926–27	71.6	13.2	3.13

[a] Summation of crops of Washington, Oregon, and California.

[b] July–June exports. These are smaller than calendar year exports. See below, pp. 339 f.

[1] Some of the flour reported as exported from the United States, especially to the West Indies, is flour milled in bond from Canadian wheat.

[2] Recent alterations in rail rates, however, have made markets of the central United States more accessible; and shipments are also made via the Panama Canal.

But the general relationships do not hold in all years; in 1922–23, for example, exports to China and Japan were much larger than in 1925–26 and 1926–27, though the crop was smaller in 1922 than in 1925 or 1926. In part this is explained by the fact that wheat prices in the Pacific Northwest were lower in 1922–23 than in the other two years, despite the smaller crop;[1] and in 1925–26 the demand for soft wheat in central regions of the United States was sufficient to cause exceptional movement by rail from the Pacific Northwest. Annual variations in exports of the United States to China and Japan are of course influenced by fluctuations in the demand in those countries. Exports in 1909–10, 1910–11, and 1921–22 might have been larger had not China been in a position to export considerable quantities to Japan. But in general a large wheat crop in the Pacific region of the United States, ordinarily accompanied by low prices, may be expected to result in relatively large exports to Asiatic countries.

The Asiatic trade of the United States consisted predominantly of flour before the war; exports of flour as wheat averaged 10.8 million bushels, and exports of wheat as grain, 2.4 million. In the post-war period, however, flour exports averaged 13.1 million, wheat exports 9.4 million. The relatively larger growth of wheat exports is due chiefly to the development of the milling industry in Japan. Flour exports to Japan averaged 2.89 million in the pre-war period, but only .94 million in the post-war period; and from 1921 to 1926 annual exports of flour declined steadily from 1,844 thousand bushels to only 83 thousand. On the other hand, pre-war exports of wheat to Japan averaged only 2.34 million bushels, as against 7.22 million in the post-war period. The remaining increase in wheat grain exports is accounted for by China, to which exports averaged only 18 thousand bushels in the pre-war period, as compared with 2,124 thousand in the post-war period. Other Asiatic countries have always been only negligible markets for wheat as grain.

The net importing countries of North and Central America provided the largest market for American wheat and flour in pre-war years, but were outranked by Asiatic countries in the post-war period. Cuba, Mexico, Porto Rico, and Haiti have always been the most important individual markets; exports to this group comprised 58 per cent of the total in the pre-war period, 66 per cent in the post-war. Preferential tariffs encourage trade of the United States with Cuba; Porto Rico and Panama Canal Zone apply no duties; and proximity in general ought to favor the United States more than other exporters in the trade with the West Indies and Central American countries. Exports of the United States to the British West Indies and to Newfoundland have, however, declined from a pre-war average of 2,562 thousand bushels to a post-war average of 1,181 thousand, on account of preferential duties favoring Canada. Exports from the United States move chiefly from Atlantic and gulf ports, but partly from Pacific ports and overland to Mexico. The Mexican trade consists chiefly of wheat; a little wheat is exported to the countries of continental Central America; other countries purchase only flour from the United States. Annual variations in total United States exports to North and Central American countries are small, and are accounted for chiefly by variations in exports to Mexico and to countries of continental Central America.

Exports from the United States to South American countries pass from Atlantic, gulf, and Pacific ports, the last supplying Peru and Ecuador particularly. Brazil has consistently been the most important market in South America; exports to Brazil averaged 47 per cent of total exports to South America in the pre-war period, 57 per cent in the post-war period. Peru and Venezuela rank next in importance. After these, British Guiana was the largest market in pre-war years, but preferential tariff arrangements have transferred this outlet to Canada. Over 92 per cent of the exports to South America consisted of flour in the pre-war period, and 78 per cent in the post-war period. Peru and Colombia are the only countries to which wheat as grain is consistently exported in fair quantities, though under special circumstances, as in 1921 and 1926, considerable quantities may

[1] See Table 13 below, p. 342.

be shipped to Brazil. Annual fluctuations in total exports from the United States to South American countries apparently depend less upon wheat crops or prices in the United States than upon production and prices in Argentina and Chile, and upon conditions affecting the demand of Brazil and Peru. Variations in exports to these countries, especially Brazil, account for the major variations in total annual exports from the United States to South America.

African countries have never provided important markets for United States wheat or flour; American exports to these destinations averaged 1.2 million bushels in the pre-war period, 2.6 million in the post-war period. The statistics are not altogether satisfactory because exports to Algeria and Tunis (usually net exporting countries) seem to be included within the official category "French Africa" until 1922, and appreciable exports of wheat as grain appear to have been made to these countries in 1912–13 and 1921.[1] Egypt is the only African market of any importance, and variations in exports to Egypt largely account for variations in total exports to African destinations. No African net importing country provides a significant outlet for wheat as grain.

The small exports to Oceania are composed almost entirely of shipments of flour to Hawaii, where United States products enjoy tariff discrimination.

Movement from Canada

A summary view of the export movement from Canada to net importing countries of ex-Europe is given in Table 4; details appear in Appendix Tables IV–VI. Before the war, North and Central American and African markets were of dominant importance; exports to these continental groups combined averaged 4.3 million bushels out of the 5.1 million shipped to all ex-European destinations. After the war Asiatic countries became by far the most important, with North and Central American second and South American third; exports to African countries showed much smaller increases than to other groups (except Oceania, to which only negligible quantities have ever been shipped from Canada), and consequently fell from second place to fourth. Before the war less than a tenth of the total Canadian exports to ex-Europe consisted of wheat; after the war exports of wheat comprised nearly half of the total. Canadian exports of wheat and flour combined have nearly quadrupled between the two periods, the absolute increase being nearly 15 million bushels. So pronounced has been the expansion since the war that the exports of 1926 were nearly eight times as large as those of 1909–10. Aside from the general growth of ex-European demand, particularly in Asia, this increase has been due chiefly to the expansion of Canadian production of wheat and flour (particularly in regions accessible to Pacific ports), to the concomitant growth of shipping facilities on the Pacific Coast, and to the preferential tariff system which enabled Canada to gain certain markets at the expense of the United States.

The Asiatic trade is of major interest

Table 4.—Canadian Exports of Wheat and Flour as Wheat to ex-European Destinations, Annually, 1909–14 and 1921–26*

(Thousand bushels)

Year	Total	North and Central America	South America	Asia	Africa	Oceania
1909–10.	3,954	2,436	160	176	1,178	4.5
1910–11.	4,669	3,434	228	91	906	10.3
1911–12.	4,707	3,200	230	320	943	14.0
1912–13.	5,433	2,965	302	598	1,568	.1
1913–14.	6,953	3,618	458	1,451	1,426	.3
Average 1909–14.	5,143	3,130	276	527	1,204	5.8
1921....	6,095	4,032	766	501	796	.0
1922....	12,814	5,589	1,247	5,075	903	.0
1923....	19,773	6,974	2,133	8,939	1,727	.0
1924....	28,603	6,389	1,916	18,654	1,644	.0
1925....	22,486	5,440	1,524	14,169	1,352	1.3
1926....	30,618	6,391	3,881	18,948	1,391	7.3
Average 1921–26.	20,065	5,802	1,911	11,048	1,302	1.4

* Pre-war figures summarized from data in *Sessional Papers, L,* 378, 386, and are for crop years July–June. Post-war figures summarized from data in *Monthly Report of the Trade of Canada.* For details, see Appendix Tables IV–VI.

[1] Since Algeria and Tunis were net exporting countries in these two years, exports to them from the United States ought not to be included in the total. In 1922, however, they were net importing countries, and United States exports are properly to be included.

since it has comprised over half the total in the post-war period. Japan and China have always been the principal individual markets in Asia; the Philippine trade is small in view of the preference given to United States products, and other countries are still less important. Before the war, when the province of Alberta was a comparatively small producer of wheat and facilities were not well developed for the movement of wheat from Alberta to Vancouver on the Pacific Coast or from Vancouver to the Orient, the United States obtained the bulk of the Oriental trade. Since the war Canadian exports to China and Japan have increased greatly, presumably in some part at the expense of the United States. Nearly three-fourths of the Canadian exports to the Orient in the post-war period have consisted of wheat as grain. Like the United States, Canada exported to China and Japan much more wheat as grain after the war than before; but unlike the United States, she has also exported more flour. Expansion of the Japanese milling industry has permitted only a small increase in exports of flour to Japan, though the increase of wheat exports has been large. China provided a larger outlet for both wheat and flour after the war than before. The larger proportion of wheat in Canadian than in United States exports to the Orient is perhaps due to the greater development of milling in Washington and Oregon than in British Columbia and Alberta; wheat is relatively more freely available for export to the Orient in Canada than in the United States and at times is presumably cheaper c.i.f. in Asia.[1]

Annual variations in Canadian exports to the Orient are apparently related to the size of the Alberta crop. The following figures show wheat production of Alberta, in million bushels, in comparison with total Canadian exports of wheat and flour to Asiatic countries, in thousand bushels:

Year July–June	Alberta crop	Canadian exports
1909–10	9.6	176
1910–11	9.1	91
1911–12	36.6	320
1912–13	34.3	598
1913–14	34.4	1,451
1921–22	53.0	3,992
1922–23	65.0	6,702
1923–24	144.8	19,235
1924–25	61.3	5,262
1925–26	98.0	17,271
1926–27	114.0	15,629

[1] Japanese millers probably find increasing need of hard wheat for blending purposes.

Since the war the concordance has been fairly close, though if it were more perfect exports in 1925–26 would not have exceeded exports in 1926–27. In 1925–26 Canada apparently obtained more than a normal share of the Oriental trade, because the Pacific Coast area of the United States was called upon to supply an abnormally heavy domestic demand for soft wheat, and consequently did not compete for the Oriental trade as actively as usual.

Newfoundland and the British West Indies, especially Trinidad and Tobago, have always been the most important markets for Canadian produce in North and Central America. Both of these extend preferential duties, which in part account for the increase in Canadian exports between the two periods; and Newfoundland is near at hand. Canada exports only negligible quantities to Mexico, for the United States is more favorably located. Since the war, in spite of tariffs favoring the United States, the Canadian trade with Cuba has approached a million bushels, about a seventh of the total exported to North and Central American countries. The trade with this group consists almost exclusively of flour. Annual variations in the volume of trade in post-war years have been small. The maximum deviation from the average, occurring in 1921, was 1.8 million bushels. For the immediate future, Canadian exports to North and Central American countries may reasonably be expected to range between 6 and 8 million bushels in any year. These shipments are made principally from the eastern coast.

Before the war, Canadian exports to South American countries averaged only 276 thousand bushels, which went almost entirely to British Guiana. Since the war, under the preferential tariff system, this trade with British Guiana has grown at the

expense of the United States. Markets have been found in Brazil, Peru, Venezuela, and other countries; and average annual exports to South America were nearly 2 million bushels in the post-war period. Exports to Brazil alone reached 1.9 million bushels in 1926, but this was largely due to the unusual circumstance of a crop of extraordinarily poor quality in Argentina. The South American trade consists principally of flour; but shipments of wheat as grain, in most years routed principally to Peru from Vancouver, have averaged 356 thousand bushels annually in the post-war period. Shipments of wheat have also been made in some years to Brazil and Venezuela, but other countries are markets only for flour shipped from the eastern coast of Canada. Except as disturbed by the unusually large shipments to Brazil in 1926, variations in annual exports are negligible.

Egypt and the Union of South Africa are the principal markets of Canada among the African countries. There has been some growth in the Egyptian trade but not in the South African; and the total has not exceeded 1.7 million bushels in any year of the periods considered. Trade with countries of Oceania, which are more readily accessible to Australia, has always been trifling.

Movement from Australia

Australian exports to ex-European net importing countries, by continental groups, are shown in Table 5; details appear in Appendix Tables VII–IX. African countries constituted the most important market for Australia before the war, and became only slightly less important than Asiatic markets in the post-war period. Asiatic markets were second in importance before the war, and first thereafter. The smaller trade with South American countries has declined, but trade with Oceania has increased. North and Central American countries have never been markets in which Australia could compete with the United States and Canada. All Australian exports of wheat and flour pass from the southern, principally the southeastern, portion of the continent. Exports to Asiatic countries except India and Ceylon move up the east coast of Australia to various destinations in the Malay Archipelago, thence northward to Japan and China; exports to India and Ceylon move westward and northward across the Indian Ocean. The latter route is followed as far as Ceylon by exports to Egypt; from Ceylon the route passes westward to Aden, thence through the Red Sea and the Suez Canal. Exports to South Africa move directly westward from the south coast of Australia. Small shipments to Peru move eastward and northward across the Pacific.

Table 5.—Australian Exports of Wheat and Flour as Wheat to ex-European Destinations, Annually, 1909–13 and 1921–26*

(Thousand bushels)

Calendar year	Total	South America[a]	Asia	Africa	Oceania
1909	8,775	627	2,051	5,412	685
1910	10,029	1,270	2,592	5,635	532
1911	11,441	1,595	4,272	4,997	577
1912	9,503	1,202	3,738	4,041	522
1913	16,534	943	5,807	9,183	601
Average 1909–13	11,256	1,127	3,692	5,854	583
1921	19,651	0	3,746	15,347	558
1922	30,027[b]	778	19,059[b]	9,756	434
1923	29,231	87	15,026	13,635	483
1924	39,641	0	19,294	16,418	3,929
1925	34,181	1,519	14,373	15,068	3,221
1926	33,491	457	17,468	12,398	3,168
Average 1921–26	31,037	474	14,828	13,770	1,965

* Pre-war figures summarized from data in *Trade and Customs and Excise Revenue of the Commonwealth of Australia.* Post-war figures summarized from data in *Monthly Summary of Australian Statistics.* For details, see Appendix Tables VII–IX.

[a] Exports reported to Peru only.

[b] Includes 6,960 thousand bushels exported to India.

Before the war, the Union of South Africa was the principal market among African countries; exports to all other countries averaged only 1.39 million bushels out of a total of 5.85 million. After the war Egypt became much more important than the Union of South Africa, and exports to Egypt averaged 9.25 million bushels as against 3.97 million to the Union of South Africa and 556 thousand to all other African countries. The increase in trade with Egypt, as we have seen,[1] resulted from the decline of European exports to that country, and cir-

[1] See above, p. 317.

cumstances which enabled Australia to enter and retain the market. The trade of the Union of South Africa has always been retained chiefly by Australia, despite the shorter distance from Argentina. Established trade routes exist between South Africa and Australia, but not between South Africa and Argentina, largely as a result of historical accident involving English trade with Australia via the Cape of Good Hope before the opening of the Suez Canal. Australia also enjoys tariff discrimination. In post-war years three-fourths of the trade of Australia with Egypt has consisted of flour; South Africa, however, has always been a market for wheat as grain, largely because duties are relatively higher on flour than on wheat.

Before the war, Australian exports to Asiatic countries averaged only 3.69 million bushels. The Dutch East Indies and the Philippine Islands were the most important markets, and shipments to them averaged 2.20 million. Shipments to China and Japan were small, always below 1.5 million bushels, and averaged only 545 thousand. After the war, exports to all Asiatic destinations increased to an average of 14.83 million bushels. The only Asiatic country to which smaller shipments were made in the post-war than in the pre-war period was the Philippine Islands. The most noteworthy increase was in shipments to Japan, which averaged 7.23 million bushels in post-war years as against only .35 million in the pre-war period; Japan displaced the Dutch East Indies as the most important market for Australia among the Asiatic countries. The Dutch East Indies, however, remained second in importance, shipments to this destination averaging 2.31 million bushels. Australia is able to compete in this region of hot moist climates chiefly because of her proximity and more regular communication, but in part, perhaps, because Australian flour can be manufactured from the exceptionally dry Australian wheat in such a manner that the flour is of lower moisture content than that of most other exporting countries, and hence keeps better.[1] Trade with China, though larger than in pre-war years, has not grown so notably as trade with Japan; pre-war shipments to China averaged .19 million bushels, post-war shipments only 1.48 million. Thus China in post-war years has obtained her supplies almost entirely from the United States and Canada; while Japanese supplies have been secured to about as large an extent from Australia as from the United States and Canada. The Oriental trade of Australia consisted almost exclusively of flour before the war; but since the war, Japan and China have provided markets for wheat grain to such an extent that over 60 per cent of the total Australian exports to Asiatic countries have been composed of wheat grain.

In some years India is an important outlet for Australian wheat. The figures in Table 5 include Australian exports to India only in 1922, when India was a net importer of wheat and flour combined. By calendar years, total exports of wheat including flour from Australia to India have been as follows, in thousand bushels:

1921	8,171	1924	19
1922	6,960	1925	134
1923	16	1926	1,277

By July–June years, the data are as follows, also in thousand bushels:

1921–22	15,067	1924–25	22
1922–23	51	1925–26	1,402
1923–24	6	1926–27	2,581

India was a net importer in the period July–June 1921–22 to a greater extent than in the calendar year 1922, and she was not a net importer in the calendar year 1921; hence average post-war net exports from Australia to Asiatic (and to all ex-European) net importing countries would appear larger on the crop year than on the calendar year basis. Exports from Australia to India occur in volume only in years when the Indian crop is notably short. Thus the Indian crop of 1921, harvested in March–May, was only 250 million bushels; and Australia was called upon for wheat chiefly during the months of October–March 1921–22. Shipments from Australia to India were negligible in the next three crop years, when the Indian crop ranged from 361 to 372 million bushels. In the following two crop years the Indian crop was of moderate size, 331 million bushels in 1925 and 325

[1] Whether or not Australian millers actually export a flour of exceptionally low moisture content to the East Indies is not known to the writer.

million in 1926, and exports from Australia to India were 1.4 and 2.6 million bushels respectively; but in these years India was not a net importing country. The small exports of Australia to other Asiatic countries than India in the calendar year 1921, some 3.75 million bushels as compared with 8.17 million exported to India and an average of 14.83 to all Asiatic countries for the post-war period, cannot be regarded as evidence that India is a preferred market among the ex-European countries. China (Manchuria) was able to export wheat in 1921, so that Japan imported from China rather than from Australia or other sources. In the calendar year 1922, when Australian exports to India were 6.96 million bushels, exports to Japan were not appreciably below average.

In the pre-war period, when New Zealand was consistently a net exporter of wheat, Australia exported only negligible quantities to that country, and total exports to countries of Oceania averaged only about half a million bushels. During the last three years of the post-war period, however, New Zealand became a net importer, and exports from Australia to New Zealand rose to over 2.5 million bushels, so that average post-war exports to countries of Oceania rose to 1.97 million.

The only South American country to which Australian exports pass is Peru, and the quantities, averaging 1.13 million bushels in the pre-war period, .47 million in the post-war period, have never been large. That any exports whatever are made is somewhat surprising in view of the proximity of Peru to Canada, the United States, Chile, and even Argentina; but there exists an established trade from Peru to Australia permitting wheat from Australia to Peru to be handled almost as ballast.

Movement from Argentina

Practically all of Argentina's exports of wheat and flour to ex-European countries pass to other South American countries, especially Brazil. Details are given in Appendix Tables X–XII.[1] Apparently no exports have ever been made to distant Oceania, and never more than 75 thousand bushels to Asia. Trifling shipments have passed to Cuba and Mexico in occasional years. Exports to African destinations, chiefly the Union of South Africa, exceeded half a million bushels only in 1925. Of total average pre-war exports to ex-European countries of 17.86 million bushels, 17.42 million went to Brazil and .37 million to other South American countries; and average post-war exports to Brazil totaled 16.42 million as against 1.01 million to other South American countries and .38 million to other ex-European countries. After Brazil, Paraguay is Argentina's principal South American market. These two countries, like Argentina, lie on the eastern coast of South America, and are thus nearer to Argentina than to any other source of supply. But Argentina has no advantage over the United States and Canada in supplying Colombia, Venezuela, and other countries in the northern portion of the continent, and is at a positive disadvantage as compared with these exporters and Chile in shipping to Peru and other importing countries on the west coast of South America.

Among the four major exporters to ex-Europe, Argentina alone has failed to increase her trade between the pre-war and the post-war periods. She has been unable to share in the growing trade with the Orient because of her distance from Asia. Moreover, she has lost, for the time being at least, a proportion of the trade with Brazil. This loss has occurred chiefly in the flour trade. Argentine exports have always consisted predominantly of wheat; her milling industry is not so well developed as those of the United States, Canada, and Australia. Before the war, Argentina exported annually some 5.37 million bushels of flour as wheat to Brazil; after the war, the figure fell to 3.00 million. Wheat grain exports did not decline, but rose from 12.05 to 13.41 million bushels. However, United States and Canadian exports of flour to Brazil increased only slightly, though exports of wheat, like those of Argentina, increased considerably. Higher Brazilian duties on flour than on wheat appear to have been the cause of Argentina's loss in flour exports. But some of the gain in United States and Canadian trade in flour

[1] See also Table 2, p. 316.

and wheat combined is due to the fact that the Argentine wheat crop harvested in December–March 1925–26 was of extraordinarily poor quality; consequently, her wheat and flour were not preferred in Brazil to the usual degree during the calendar year 1926.

Movement from Minor Exporters

India, Chile, China, Uruguay, Irak, Persia, Syria and Lebanon, Eritrea, and New Zealand are countries which usually or occasionally export some wheat and/or flour to ex-European destinations. Of Eritrea and New Zealand nothing need be said, for their contributions to the total exports to ex-European destinations have always been negligible. Of Irak, Persia, and Syria and Lebanon nothing can be said because data are not available showing the distribution of their occasional exports between Europe and ex-Europe. The omission of Irak may be of some significance because her net exports exceeded 3.5 million bushels in 1923, and a fair proportion of these may have gone to ex-Europe.

India (see Table 2, p. 316, and Appendix Tables XIII–XV) exported, on the average, about 3 million bushels of wheat and flour a year to ex-Europe in the pre-war period, and only slightly more in the post-war period. Exports move only to Asiatic and African countries, and principally to western Asia and British Africa, especially Egypt. Egypt is the largest single market. Exports from India to ex-Europe consist chiefly of flour; wheat exports to ex-Europe averaged less than half a million bushels in 1909–13, and not much more in the post-war period. In 1924–25, however, when the Australian crop was small and the Indian crop large,[1] the largest exports of wheat as grain recorded in the two periods were made to Egypt; but the total amounted only to 2.23 million bushels. In this year India's total exports to ex-Europe, 7.4 million bushels, were larger than in any other year of the two periods; the high figures reflect two fine crops in succession, the coincidence of a small Australian and a large Indian crop, and much higher international prices in 1924–25 than in 1923–24. In the Indian crop year 1922–23, when the country was a net importer of wheat and flour, exports to ex-European destinations continued, though in somewhat smaller quantities than usual.

Chile (see Table 2, p. 316) exported only some .74 million bushels to ex-European countries in the pre-war period, and 1.50 million in the post-war period. The principal markets are Peru and Bolivia; shipments to Ecuador and Brazil have not reached 50 thousand bushels in any year. Annual fluctuations in Chilean exports depend principally upon the size of the domestic crop; in some years the crop scarcely suffices for domestic requirements, while in others, like 1924, a good crop permits exports of 3 million bushels or more. Exports consist chiefly of wheat as grain. Exports to Peru and Bolivia are made even in years when Chile is forced to import some wheat, as in 1922.

China has been a net exporter of wheat and flour combined only in a few years, 1909, 1910, and 1921. Throughout the pre-war period she was a net exporter of wheat as grain; in 1909 and 1910 she was also a net exporter of flour, but in 1911–13 net imports of flour exceeded net exports of wheat as grain. Net exports totaled 2.3 million bushels in 1909 and 5.3 million in 1910. In 1921 also, following a war-time expansion of wheat production, China was a net exporter of wheat and flour, to the extent of 15.3 million bushels. Japan, western Asiatic countries, and Siberia were the leading ex-European markets in this year.

Uruguay is consistently a net exporter both of wheat and of flour; in some years her total net exports to all destinations exceed 5 million bushels. Data are not available, however, for distributing these exports between European and ex-European countries. Perhaps 2 million bushels are exported to Brazil and Paraguay, principally the former, in years when the Uruguayan crop is large; these two countries are the only important ex-European markets. Exports of wheat as grain are much larger than exports of flour.

[1] Although the Australian crop harvested in December–February 1923–24 is regarded as the crop of 1923, and the Indian crop harvested in March–June 1924 as the crop of 1924, these are the crops which competed and to which reference is made above.

IV. DISTRIBUTION OF NET IMPORTS

A General View

In the present section we shall deal with net import statistics, particularly with pre-war and post-war averages for different countries and groups of countries. In so far as the meager data permit, it will be desirable to analyze trends in the consumption of wheat, with the object of determining whether or not increases or decreases in trade shown by averages are likely to continue in the near future. Annual data for post-war years are given in Tables 6–12; but consideration of the factors governing fluctuations in the annual volume of trade is reserved for the following section, and can best be treated by reference to statistics of crop year exports to ex-Europe.

A distribution of the net imports of ex-European countries by continental groups is given in Table 6. In the pre-war period

Table 6.—General Distribution of ex-European Net Imports of Wheat and Flour as Wheat, Pre-War and Post-War*

(Thousand bushels)

Calendar year	Total	North and Central America	South America	Asia	Africa	Oceania
Ave. 1909–13	79,884	17,539	27,370	14,800	18,845	1,330
1921...	85,259	20,134	23,305	24,611	15,730	1,479
1922...	110,078	20,264	29,082	45,694[a]	13,882	1,156
1923...	126,362	24,252	31,032	50,565	19,306	1,207
1924...	162,994	23,967	38,761	73,200	22,165	4,901
1925...	128,037	21,164	36,614	42,822	23,429	4,008
1926...	150,448	23,373	40,269	62,644	19,826	4,336
Ave. 1921–26	127,197	22,193	33,177	49,923	19,056	2,848

* Summarized from data of International Institute of Agriculture. See Tables 8–12 for detailed lists of countries within continental groupings. The figures given include our estimates of imports of individual countries in particular years. Pre-war averages are not always for the five years 1909–13. Metric quintals of wheat converted to bushels at 3.67431 bushels per quintal; metric quintals of flour converted to bushels of wheat at 5.24902 bushels (a 70 per cent extraction) per quintal.

[a] Includes 2,510 thousand bushels of imports into India.

South American countries imported more wheat and flour than any other continental group, some 27.4 million bushels out of a total of 79.9 million. African countries, and North and Central American countries, with 18.8 and 17.5 million bushels respectively, were next in importance; Asiatic countries ranked fourth. Oceania imported less than 1.5 million bushels. In the post-war period the Asiatic group became the most important; South America took second place, North and Central America third, Africa fourth, and Oceania fifth. In so far as growth of imports reflects growth of demand, it is clear that the significant increases in demand have occurred in Asia, South America, and North and Central America.

In general, the increase in demand has apparently been more noteworthy with respect to wheat than to flour. Table 7

Table 7.—General Distribution of ex-European Net Imports of Flour as Wheat, Pre-War and Post-War*

(Thousand bushels)

Calendar Year	Total	North and Central America	South America	Asia	Africa	Oceania
Average 1909–13.	59,091	15,471	12,046	14,873	15,344	1,357
1921....	51,715	17,472	6,627	12,820	13,677	1,119
1922....	63,149	18,744	10,404	21,900	11,021	1,080
1923....	76,565	22,110	9,487	29,568	14,283	1,117
1924....	88,980	22,273	14,949	34,651	15,857	1,250
1925....	72,590	19,551	13,653	21,409	16,304	1,673
1926....	84,455	20,253	17,577	28,367	15,690	2,568
Average 1921–26.	72,909	20,067	12,116	24,786	14,472	1,468

* See Table 6 for sources and qualifying notes.

shows net imports of flour by continental groupings. There has been no increase or no appreciable increase in the flour imports of South America, Africa, or Oceania. The increase in Asiatic flour imports appears to have been considerably less than the increase in wheat imports. The general policy throughout the world to encourage domestic milling by relatively higher duties on flour than on wheat has apparently achieved a considerable measure of success in ex-European countries. Only North and Central America—a group composed largely of tropical or semi-tropical countries where wheat is neither grown nor milled—has shown an increase in flour imports greater than in wheat imports.

The increase in annual average net im-

ports of ex-Europe between two periods so distant from each other as 1909–13 and 1921–26 must be due to such fundamental influences as long-time trends in wheat production, in population growth, and in per capita consumption of wheat. It is impossible to analyze each of these factors for each ex-European country or for each continental group; the data are fragmentary. Yet a reasoned guess at the future trend of ex-European trade in wheat and flour cannot be formulated without some attempt to comprehend trends in wheat production and consumption in ex-European countries. The unqualified data of Table 6 suggest that total ex-European trade has increased at the rate of 3.6–3.9 million bushels per year; if this rate of increase were maintained, ex-European trade would on the average exceed 170 million bushels annually in 1933–37, a period as distant from 1921–26 as 1921–26 is from 1909–13. But the historical rate of increase has differed greatly between different countries; and before one can reasonably conclude that similar rates of increase are likely to continue in the future, it is desirable to examine the wheat situation in particular regions in further detail.

Imports of Asia

Table 8 (p. 328) shows Asiatic net imports of wheat and flour combined, distributed among the various important importing countries. All countries or groups of countries except the group designated "others" have increased their net imports considerably between the pre-war and the post-war periods. Even this single decline in imports is open to question. Among the several specific countries listed in the group designated "others," only French India and the Federated Malay States had smaller imports in the post-war than in the pre-war period; and since the imports of French India are negligible, the apparent decline in the imports of the Federated Malay States accounts almost entirely for the decline in the imports of the group "other countries." In view of the fact that imports have increased in every other Malayan country, the figures for the Federated Malay States may reasonably be questioned. A decline probably did not occur; but whether the pre-war figures are too high or the post-war figures too low is not clear.[1] One may reasonably conclude that among the net importing countries of Asia there is no group which failed to show an increase in net imports between the pre-war and the post-war periods.

Japan and China are the countries where the increase was most noteworthy; the increase in net imports of these two countries was 31.4 million bushels, as against an increase of 35.1 million in all Asiatic countries and of 47.3 in all ex-European countries. Hence these are the countries where the wheat situation deserves most detailed analysis.

Yet the increase in the combined imports of other Asiatic regions has not been negligible, and may be considered first. On the assumptions that the Federated Malay States have in fact increased their imports in the same proportion as the Dutch East Indies, and that the post-war trade figures are correct, total net imports of the Asiatic countries which produce no wheat have increased from 6 to 9.6 million bushels, or 60 per cent. The trade of these non-wheat producing countries[2] consists almost entirely of flour. Rice is the staple cereal food; wheat is imported in part for the European population to consume in the form of bread, in part for the native population to consume in the form of noodles or dumplings. There is no statistical evidence that wheat tends strongly to displace rice in the diet. In the Philippines, for example, the per capita disappearance of wheat has increased from 12 pounds per annum in 1909–13 to 18 pounds in 1921–26, while the per capita disappearance of rice has increased from 246 to 383 pounds. In the

[1] Another reason for questioning the accuracy of the reported net imports of the Federated Malay States lies in the fact that the net import of flour in 1921 is given as 321,774 quintals in the *International Yearbook of Agricultural Statistics, 1909 to 1921,* but as 80,090 quintals in the *Yearbook* of 1922, without explanatory notes. It seems more reasonable to suppose that there has been a change in the basis of the statistics than that there has been a decline in net imports.

[2] The list includes Ceylon, the Dutch East Indies, the Philippine Islands, Indo-China, French India, Portuguese India, British Borneo, the Straits Settlements, the Federated Malay States, and the Protected Malay States. No data are available for Siam.

Dutch East Indies, the trifling per capita disappearance of wheat increased from 2.5 to 3.1 pounds, while disappearance of rice increased from 234 to 239 pounds. In Ceylon, disappearance of wheat increased from 7 to 11 pounds, while disappearance of rice decreased from 319 to 316 pounds.[1]

If these countries are typical of their class, increased importation and consumption of wheat flour in the non-wheat-producing and rice-consuming countries of Asia appears to have been an incidental factor in a general increase in per capita cereal consumption, which itself represents an improvement in the standard of living. Dietary habits change slowly, especially in Asia. Consequently one cannot expect any sudden increase in wheat consumption in the rice-consuming countries; for the next few decades rice consumption will probably continue to expand quite as rapidly as wheat consumption wherever there is further possibility of raising the standard of living. Nevertheless it is reasonable to assume that wheat will hold its subordinate place in the diet, and that imports will increase at about the same rate as in recent years. There is presumably room for still further increases in per capita consumption both of wheat and of rice, before reaching the stage of decreasing consumption of cereals with increasing substitution of sugar, meats, and vegetables. Population also will probably continue to increase; and, since these countries cannot produce wheat, imports of flour will probably increase with the population growth alone. Furthermore, the trade figures for recent years (see Table 8) suggest that flour consumption there is not greatly affected by changes in wheat prices; imports do not fall off sharply in years of high wheat prices like 1925. So far as the meager data are trustworthy, it seems reasonable to anticipate for the immediate future a rate of increase in imports averaging around 5 per cent annually in the non-wheat-producing countries of Asia, Asia Minor, and the Arabian Peninsula.

This increase in flour trade will presumably be supplied chiefly by Japan and Australia. Both countries are relatively near at hand and are able to furnish regular shipments in small lots, an important matter in securing the trade of countries with

TABLE 8.—NET IMPORTS OF WHEAT AND FLOUR AS WHEAT INTO ASIATIC IMPORTING COUNTRIES, PRE-WAR AND POST-WAR*

(Thousand bushels)

Calendar Year	Total	Japanese Empire[a]	China[b]	Philippines	Dutch East Indies	Western Asia[c]	Indo-China	Ceylon	Others reported[d]
Average 1909–13.....	14,800	4,854	417	1,832	1,747	1,824	508	523	3,095
1921.....	24,611	12,591[e]	[f]	4,701	2,210	2,251	652	778	1,428
1922.....	45,694[g]	23,761	8,968	2,204	2,209	3,119	673	643	1,607
1923.....	50,565	18,861	22,499	2,760	2,299	629	840	737	1,940
1924.....	73,200	28,960	31,765	3,274	2,672	2,512	1,010	857	2,150
1925.....	42,822	16,879	9,193	3,654	2,798	6,152	927	858	2,361
1926.....	62,644	24,048	22,760	3,517	3,334	4,518	1,000	960	2,507
Average 1921–26.....	49,923	20,850	15,864	3,352	2,587	3,197	850	805	1,999

* See Table 6 for sources and qualifying notes.

[a] Japan, Chosen (Korea), and Formosa.
[b] Includes Macao, but not Hongkong or Kwantung, or other foreign possessions or leased territories.
[c] Palestine, Syria, Lebanon, Cyprus, Aden, Irak, Persia.
[d] French India, Portuguese India, British Borneo, Straits Settlements, Federated Malay States, Protected Malay States.
[e] Japan only.
[f] Net exports of 15,335 thousand bushels; ignored in striking average of net imports for the period.
[g] Includes 2,510 thousand bushels for India.

[1] The per capita disappearance figures employed in this study are obtained by dividing the pre-war and post-war averages of domestic production plus net imports by estimated population in the middle of each period. Per capita disappearance may be regarded as a very rough indication of per capita consumption for food, though no account is taken of the use of crops for seed, feed, or industry. Since the figures are in part based in many instances on very rough estimates of population and production, they must be used with caution.

a humid tropical climate. Both can supply soft flour of the type suitable for noodles. Australian flour is said to keep somewhat better than other flours, and is consequently preferred to some extent.[1]

In the countries of western Asia the problem is more complex. Here wheat is produced in large volume, and flour in the form of hard bread and pastes is the staple cereal food. On the whole the area imports more flour than wheat, but the situation varies from country to country and from year to year. Moreover, the detailed trade data are decidedly incomplete; and for several countries data on wheat production and even population are not available. With data so unsatisfactory, calculations of per capita disappearance of wheat and other cereals are not feasible. Western Asia, however, is generally regarded as an area which is underpopulated with respect to its agricultural resources. Much land is thought to be suitable for crop production, and existing methods of cultivation are most primitive. It seems likely that agricultural production has not yet recovered even to the level of pre-war years. A decade or two of peace, with recovery and improvement of agriculture and industry, and extension of transportation facilities, might involve such expansion of wheat production that the area might consistently export wheat in fair quantities. Too little is known of present and past conditions to justify more than a guess; but on the whole there seems little prospect that the wheat and flour imports of the post-war period will be further increased or even maintained.

Japan and China

Net imports of wheat and flour into the Japanese Empire have increased from 4.9 million bushels in 1909–13 to 20.9 million in 1921–26. Japan has consistently imported more wheat than flour. The domestic milling industry has been encouraged by the imposition of duties favoring the importation of wheat; and the policy has been so successful that Japan became a net exporter of flour in 1925 and 1926. The policy involves expansion of the milling industry only in Japan, not in Chosen (Korea) or Formosa. The market for flour in Formosa is retained by Japanese millers through the high duty on foreign flour. Chosen sends wheat to Japan, but imports flour thence. Similarly Japan imports wheat from north Manchuria when the crop permits, and exports flour to south Manchuria and various points in China proper. The proximity of Japan to China, with the existence of established means of communication, places Japan in a favored situation for securing the flour trade of China. Unless the milling industry in China overtakes the Japanese, it seems probable that the Chinese flour import trade will pass more and more largely into the hands of Japanese millers.

Between the pre-war and the post-war periods, Japan increased not only her net imports of wheat and flour, but also her domestic production of wheat, from 32 to 38.6 million bushels. The per capita disappearance of wheat increased from 30 to 46 pounds. Wheat is consumed in some part in the form of bread, but probably in larger part in the form of noodles. Native wheat is soft, and suitable only to provide the soft flour satisfactory for noodles. There is probably a tendency for wheat to play an increasingly important part in the Japanese diet, especially in the form of bread. But the statistical evidence does not suggest that wheat tends to displace rice; per capita disappearance of rice increased from 385 to 434 pounds between the pre-war and the post-war periods, a much larger absolute increase than occurred with respect to wheat. This is striking if, as is said to be the case, wheat flour is usually cheaper than polished rice per unit of weight. Japanese preference for rice is not likely to be altered for many years to come. Nevertheless the mass of the population seems not to be undernourished; the deficiency apparently lies in the lack of protein in the diet, not in insufficient starch.[2] Per capita consumption of wheat may continue to increase, in the future perhaps at the expense of rice. The bread-eating habit is already further developed in Japan than in any other country of eastern Asia, parts of

[1] See *Northwestern Miller*, April 18, 1928, CLIV, 237.

[2] See Shozo Toda, "The Actual Consumption of Food in Japan," *Japan Medical World*, February 15, 1927, VII, 41–45; also Edgerton Charles Grey, "Has Japan Enough to Eat?" *Asia*, April 1928, XXVIII, 274–79, 339–42.

China perhaps excepted. With continuing industrial prosperity, increasing adoption of European customs, and governmental efforts directed toward decreasing the consumption of rice, the diet of Japan may become more diversified. Wheat seems likely to be the article chiefly substituted for rice.

It is not altogether certain, however, that net imports of wheat must increase even if population and per capita consumption increase. There is apparently room for some further expansion of domestic wheat production in the more northerly regions, especially the island of Yezo (Hokkaido), perhaps also in Chosen. But the cultivation of new land in Yezo appears to proceed slowly, and wheat acreage in Japan and Chosen has tended to decline rather than to increase since the war. Increased consumption will probably be met more by increased net imports than by increased domestic production. How all of the influences will work out cannot be forseen. One may reasonably expect no decline in Japanese consumption or importation of wheat from the level reached in 1921–26. On the other hand, so marked an increase as occurred between 1909–13 and 1921–26 is doubtful over an equivalent length of time; for a considerable part of the recorded increases in consumption and net imports was presumably due to the exceptional advance in Japanese prosperity caused indirectly by the war. Japan may well hold her gains and indeed continue them, though perhaps at a less rapid rate. Between 1921–26 and 1933–38 an increase of 50 or even 100 per cent in Japanese net imports of wheat and flour would not be surprising; but an increase of 330 per cent, such as occurred between 1909–13 and 1921–26, seems unlikely. Whatever the increase, it will probably take the form of wheat grain.

The Chinese situation is much more difficult to evaluate. China is known to rank among the large wheat-producing countries of the world; but there are no approximately reliable statistics of production.[1] Authorities are not agreed even upon the population. Consequently no reliable estimates can be made of per capita consumption, and one cannot ascertain whether there has been an increase or a decrease between the pre-war and post-war periods. All that is known from statistical data is that there has been an increase in net imports from .4 million bushels[2] to 15.9 million. The general impression of observers seems to be that wheat consumption per capita in China tends to increase; but this may be true of some sections and not of others.

China is by no means a unit with respect to wheat production and consumption. Production seems to be concentrated chiefly in the eastern provinces of China which lie north of the Yangtze River—in Hupeh, Anhwei, Kiangsu, Honan, Shangtung, and Chihli. A good deal is also grown in northern Manchuria. Very little is grown in the southeastern provinces of China such as Chekiang, Fukien, Kiangsi, Kwantung, and Kwansi, and in the southwestern and northwestern provinces wheat production appears to be only scattering. Some notion of the distribution of wheat production may be obtained from the location of cities which are the leading milling centers. Of these Shanghai and Wusih are in Kiangsu; Tsinan is in Shantung; Tientsin is in Chili; Hankow is in Hupeh; Harbin and Changchun are in Manchuria. There are less important centers in Shansi, Honan, Szechwan, Hunan, Anhwei, and Yunnan.[3]

With respect to wheat consumption, China falls into two broad divisions following in general the distribution of wheat and rice production. South of the Yangtze, wheat is not a large factor in the diet. Rice is by far the dominant cereal crop both in production and consumption; and in this area wheat seems unlikely to become of any appreciable importance. Even in Hupeh, which is a large producer of wheat lying north of the Yangtze, rice is the pre-

[1] How ideas vary regarding Chinese wheat production may be seen from the fact that Mr. Julean Arnold, United States commercial attache at Peking, stated in 1922 that "the amount must be upward of 100,000,000 bushels" (U.S. Department of Commerce, *Trade Information Bulletin No. 5*, March 1922), while the Goode-Baker Series of Economic Wall Maps gives the average annual production in 1918–20 as 536 million.

[2] By another method of calculation, however, the pre-war figure is 1.9 million. See above, p. 310.

[3] See D. K. Lieu, "China's Industrial Development," *Chinese Economic Journal*, July 1927, I, 663 f; cf. "Flour Mills in China," *ibid.*, June 1928, II, 533–41.

ferred food. Hupeh produces more than three times as much rice as wheat,[1] and though rice is imported into the province in large quantities, wheat exports to other provinces or abroad are said to make up about a half of the total moving from all provinces.[2] Hence rice appears to be the preferred cereal food in Hupeh, as in the provinces south of the Yangtze. In Szechwan, which also lies immediately north of the Yangtze, very little wheat is said to be grown in most parts of the great agricultural plain, and rice is the main article of food.[3]

To the north, however, where the climate is dryer and colder, wheat is apparently an important article in the diet, while rice is subordinated. Yet wheat is not the staple cereal food of the bulk of the population. It appears to occupy a middle ground between the millets (including *kaoliang*) and maize on the one hand, and rice on the other. In general the peasants and laborers consume millets, *kaoliang,* and maize; the middle classes consume wheat flour; the distinctly well-to-do consume rice. Prices of these cereals per 1,000 calories appear to run in about the same relationships, with rice above wheat and the millets and maize below it. Of course habits of consumption must vary from region to region, but in general these relationships appear to hold.[4] Apparently wheat is nowhere extensively consumed in China in the form of yeast-leavened fine white bread. Coarse, hard, dark bread is made, especially for rural consumption, and there is a large consumption of noodles and dumplings.

Whether or not Chinese net imports of wheat and flour will increase in the future as they have done between the pre-war and post-war periods depends chiefly upon establishment of internal peace, growth of general prosperity, and upon the trend of domestic wheat production. There can be little doubt that the laboring and farming classes of northern China would prefer wheat to the millets and maize as the staple cereal food if they could afford it. If the political situation finally clears up so that internal development can proceed unhampered, then the general level of Chinese prosperity may be raised and wheat may be much more in demand.

It is impossible to foresee whether or not an increase in demand could be met by an increase in domestic production; for too little is known either of uncultivated areas suitable for wheat production or of the position which wheat occupies with respect to other crops. Methods of cultivation are primitive and transportation lacking. In northern Manchuria, now a surplus wheat-producing region, production of wheat in recent years has not increased so rapidly as production of beans, *kaoliang,* Italian millet, corn, or other cereals, despite a continuous increase in area under cultivation due to immigration from more southerly provinces.[5] A sharp decline in north Man-

[1] "Agriculture in Hupeh," *Chinese Economic Journal,* February 1927, I, 166. The annual crop of rice is given as 60.5 million piculs, of wheat and barley combined as 20 million.

[2] Friedrich Otte, "Sketch of Chinese Agricultural Policy," *ibid.,* May 1928, II, 370.

[3] H. D. Brown and Li Min Liang, "A Survey of 50 Farms on the Chengtu Plain, Szechwan," *ibid.,* January 1928, II, 45.

[4] The following quotations, all of which mention wheat consumption in northern provinces of China, are pertinent:

"The daily food for a farm hand consists of 2 catties of wheat flour in the summer and autumn and 2½ catties of millet and maize for the rest of the year."—"Tehchow, an Important Town of Northern Shantung," *ibid.,* August 1927, I, 759.

"The staple food of the rural population is *kaoliang* and maize, varied occasionally with wheat flour in summer time."

"The staple food of the local population of the poorer classes is maize, *kaoliang,* and millet. Only the well-to-do use wheat flour."

"The staple food of the local population is *kaoliang* and maize for the peasants and wheat flour for the city dwellers."—"Three Towns in Southeastern Chihli," *ibid.,* November 1927, I, 983, 986, 989.

"Rice and machine-milled wheat flour are the staple food of those who belong to the clerical and teaching classes, while manual laborers generally consider these as luxuries. Their usual food is millet, 'millet flour,' and corn flour."—"Retail Prices in Peking in 1926," *ibid.,* April 1927, I, 313.

"The staple food of the rural population consists chiefly of millet, maize, *Kaoliang,* and beans, while the well-to-do classes in the city generally eat wheat flour."—"Huantan, an Agricultural Center of Chihli," *ibid.,* May 1927, I, 472.

"The inhabitants of Shihchiachwang are living on a much higher economic plane than those in neighboring districts. For daily food, the well-to-do consume rice, the middle class, wheat flour, and the poorer classes, millet."—"Three Towns on the Peking-Hankow Railway," *ibid.,* June 1927, I, 563.

"Peking workmen eat cereals of the coarser kinds, corn and millet being the most popular."—Ta Chen, "Retail Prices in Peking," *ibid.,* June 1927, I, 594.

"As cash crops wheat and soy beans are somewhat in competition, while kaoliang and millet are grown for farm and local consumption."—U.S. Department of Agriculture, "The Wheat and Flour Industry in Manchuria," *Foreign News on Wheat,* November 7, 1927.

[5] North Manchurian production of staple crops in 1922–26 is given as follows, in thousand metric tons, by A. A. Neopihanoff, "The Development of North

churian wheat production occurred between 1922 and 1923; the crop was a failure in the latter year. Observers state that the millets and soy beans are safer crops in Manchuria because the climate favors late-maturing crops.[1] Under these circumstances there seems to be little probability that north Manchuria, apparently the only region of China in which much new land is available for wheat production, will become so large a producer as to satisfy the demand likely to arise throughout northern China. But north Manchuria is by no means the only wheat-producing region of China; and less is known of these other regions. They are densely populated and intensively cultivated. More wheat could probably be grown and marketed in the absence of such political disturbances as have prevailed during a good part of the post-war period.[2]

On the whole it seems somewhat more reasonable to anticipate for the next few decades an increase rather than a decrease in China's net imports of wheat and flour. The demand likely to become effective if, as, and when political instability is reduced and economic progress accelerated seems larger quantitatively than the probable increase in domestic production. Variations in the quantities imported annually, however, will presumably always be considerable, if only because variations in the domestic crop are ordinarily large in all countries where wheat is produced in large volume. China, like Japan, will perhaps tend to import proportionately less flour and more wheat. The domestic milling industry is by no means underdeveloped and is apparently not ill managed, and with unhampered transportation of wheat and flour could probably supply the flour needs of the country without difficulty. Since fine white bread is not extensively consumed in China, imports will doubtless continue to consist either of soft wheat and flour or of the lower and cheaper grades of Canadian hard wheat.

Thus among the several territorial divisions of Asia, only western Asiatic countries seem likely to require smaller net imports of wheat and flour in the future than were reported on the average for 1921–26. For Asia as a whole increased net imports are to be expected in the future. But the situation with respect to wheat production and consumption differs so widely in different countries that the extent of the probable increase in total Asiatic net imports can be stated only in the most general terms. There seems little reason to expect, over an equivalent length of time, so large a percentage increase as occurred between the pre-war and the post-war periods, some 237 per cent. But as large an increase in absolute terms, some 35 million bushels more or less, is conceivable and reasonably probable.

Imports of Africa

In sharp contrast with Asiatic countries, African countries increased their net imports of wheat and flour very little between the pre-war and post-war periods, from 18.8 to 19.1 million bushels. But, as appears from Table 9, the situation differs between different countries or dependencies. The net imports of Egypt and the Anglo-Egyptian Sudan increased while those of the Union of South Africa decreased; increases appeared in the imports of other British Africa, of French Equatorial and West Africa, and of Italian possessions, but there were decreases in the imports of other French Africa and of all other African countries and dependencies than those named.

The African trade consists predominantly of flour. Wheat is grown only in northern Africa (Morocco, Algeria, Tunis, and Egypt), in the Union of South Africa, and in the highlands of Kenya in southeastern

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Manchuria," *Chinese Economic Journal,* March 1928, II, 261:

Crop	1922	1923	1924	1925	1926
Wheat	1,245	508	573	590	686
Yellow beans	2,293	2,211	2,875	3,080	3,259
Kaoliang	1,507	1,671	1,900	2,130	2,194
Italian millet	1,638	1,721	2,048	2,228	2,296
Indian corn	901	901	983	1,098	1,142
Other cereals	1,180	1,344	1,427	1,491	1,536
Total	8,764	8,356	9,806	10,617	11,113

[1] See U.S. Department of Agriculture, "The Wheat and Flour Industry in Manchuria," *Foreign News on Wheat,* November 7, 1927.

[2] For an extended discussion of the Chinese situation not available when this study was in preparation, see *ibid.,* August 14, 1928.

Africa. The French dependencies of northern Africa usually export wheat but import flour; milling is not well developed, and the French colonial policy does not encourage it. In Egypt also the native crop is milled locally by primitive methods, and flour rather than wheat is imported. In the Union of South Africa milling is better developed than elsewhere in Africa, and in recent years has been protected by relatively higher duties on flour than on wheat. Union of South Africa, wheat plays a distinctly small part in the diet of the various African countries and dependencies.

Neither the reasons for the relatively small increase in African net imports, nor the prospects for growth of African trade, are clear. A slightly greater growth would have appeared in the imports of the group of dependencies designated "Other French Africa" if the pre-war average figure were not so heavily weighted by net imports of

TABLE 9.—NET IMPORTS OF WHEAT AND FLOUR AS WHEAT INTO AFRICAN IMPORTING COUNTRIES, PRE-WAR AND POST-WAR*

(Thousand bushels)

Calendar Year	Total	Egypt and Sudan	Union of South Africa	Other British Africa[a]	French Equatorial and West Africa[b]	Other French Africa[c]	Italian possessions[d]	Other Africa[e]
Average 1909–13	18,845	8,627	6,443	1,348	334	947[f]	653	493
1921	15,730	11,566	1,489	1,131	117	173	892	362
1922	13,882	5,935	2,864	1,452	265	2,039[g]	799	528
1923	19,306	8,599	6,998	1,721	490	221	823	454
1924	22,166	9,196	7,703	1,974	690	219	1,878	506
1925	23,429	12,832	6,132	1,975	574	286	1,123	507
1926	19,826	11,253	4,541	1,888	577	264	759	544
Average 1921–26	19,056	9,897	4,954	1,690	452	534	1,046	483

* See Table 6 for sources and qualifying notes.

[a] Gold Coast, Gambia, Kenya, Mauritius, Nigeria, Uganda, North and South Rhodesia, Seychelles, Sierra Leone, British Somaliland, Tanganyika, British Southwest Africa, Togoland, and Zanzibar.
[b] Gabon, Mid-Congo, Ubangi, Ivory Coast, Dahomey, Guinea, Senegal, Sudan.
[c] Cameroon, Somaliland, Madagascar, Réunion, Togo.
[d] Libya, Somaliland, Eritrea, Cyrenaica, Tripolitania.
[e] Cape Verde, Belgian Congo, Mozambique, Angola, Liberia, Saint Thomas and Prince Islands.
[f] Includes net imports of Tunis of 742 thousand bushels.
[g] Includes net imports of 1,253 thousand bushels of Algeria, and 605 thousand bushels of Tunis.

Before the war, the net imports of the Union of South Africa were about half of flour and half of wheat, but after the war, one-third of flour and two-thirds of wheat. Among all African countries, only the Union of South Africa consistently imports fairly large quantities of wheat.

Egypt (including the Sudan) and the Union of South Africa have always been the largest importers among the African countries and dependencies. Before the war the net imports of these two were 15.1 million bushels as compared with a total of 18.8 million; after the war, 14.9 as against 19.1 million. Other British African dependencies ranked next in importance, but imported only 1.3 million bushels in 1909–13 and 1.7 million in 1921–26. Except in Morocco, Algeria, Tunis, Egypt, and the Tunis, which amounted to 742 thousand bushels out of 947 thousand. Tunis has been a net exporter since the war except in 1922. The net imports of "Other French Africa" would show an increase from 205 to 224 thousand bushels rather than a decrease from 947 to 534 thousand, if net imports of Tunis in 1909–13 and 1922 and of Algeria in 1922 were not included in the calculation. Such significant decreases in net imports as have been recorded have occurred in Tunis, the Union of South Africa, and the Belgian Congo. Other African countries have increased their net imports, though not greatly.

Net imports of the Union of South Africa decreased from 6.4 to 5.0 million bushels between the two periods. The reasons are difficult to perceive. Domestic wheat pro-

duction increased, but increased population and decreased net imports apparently led to a decline in per capita disappearance from 127 to 102 pounds per annum. Per capita disappearance of rice also declined, from 13 to 11 pounds; but per capita disappearance of maize increased from 241 to 328 pounds. This does not necessarily imply a shift in human cereal consumption from wheat and rice to maize. The Union produces livestock heavily, and the increase in maize disappearance may have been due to an increase in the livestock population or to changes in feeding practices rather than to larger use of maize for human food. Moreover, net imports in 1921 and 1922 appear to have been exceptionally low, probably as an aftermath of the war. The apparent decline in per capita disappearance of wheat is probably only temporary, and averages for 1923–26 rather than 1921–26 certainly show it to be much less marked. The large indigenous population of the Union of South Africa, and of many other central and southern African areas as well, probably represents a large potential demand for wheat; and this demand may become effective under the slow advance of European civilization.[1] Presumably it will be met by imports, since wheat is an uncertain crop, yield per acre is low, and there are apparently no considerable areas suitable for wheat production.[2] Hence more reasons appear for anticipating increased than decreased net imports into South Africa, but the increases are likely to be slow, as well as irregular on account of fluctuations in domestic production. With established trade routes and tariff preferentials, Australia will presumably continue to supply most of the soft wheat and flour, Canada the hard wheat flour.[3]

Egypt, the largest single importer among the African countries, increased her net imports from 8.6 to 9.9 million bushels between the pre-war and post-war periods. Domestic production also increased; but per capita consumption apparently declined from 215 to 202 pounds per annum. Rice disappearance also declined from 73 to 38 pounds per capita, and maize disappearance remained stable at about 290 pounds. Egypt has a much smaller livestock population than the Union of South Africa; and per capita human consumption of meat is lower, of the various cereals, including the millets, higher. The apparent declines in per capita disappearance of wheat and rice are not unreasonable in view of the fact that the great bulk of the population consists of laborers who suffered from rather than benefited by the advancing prices during the war. Landowners presumably profited greatly by high prices, especially of the great cash crop of Egypt, cotton; but wages seem not to have risen so rapidly as food prices, and the meager diet of the laboring classes may have been curtailed. There is probably room in Egypt for considerable expansion of wheat consumption at the expense of maize and the millets, but expansion must presumably be very slow. Further increases in wheat imports might be expected from this cause alone, but whether or not increases occur depends in large part upon the profits of cotton cultivation. Egypt already produces much more wheat than she imports, and could undoubtedly produce more if cotton-growing should appear unremunerative. But at present cotton cultivation is well established, and a shift to wheat production seems remote. Consequently increasing net imports of wheat and flour seem probable for some years to come.

Thus in Africa as a whole, as in Asia, there is apparently a large potential demand for wheat and wheat flour. Only in the French dependencies of North Africa does there appear to be any probability that increasing domestic requirements can be

[1] "There cannot be the slightest doubt of the future of the flour trade of the sub-Continent. Of a native population of perhaps 30,000,000, probably not more than 5 per cent are flour eaters at present. Yet in course of time all this native population will be wheat consumers, as experience proves that any native race will desert its traditional foods for bread. Every native who is compelled or persuaded, as a result of new desires, to sell his labour is almost certain to become a wheat consumer at his earliest opportunity." G. R. Stevens, Canadian Trade Commissioner in South Africa, *Trade of the African Sub-Continent*, Ottawa, 1928, p. 75.

[2] Outside of the Union of South Africa, the potential wheat-growing areas seem to be in the highlands of Kenya and of southwestern Tanganyika.

[3] Throughout the sub-continent bakers are said to blend "one bag of Canadian second patent to four bags of Australian or South African soft wheat flour." *Ibid.*, 77. India also exports some flour to the southeastern coast of Africa.

met by domestic wheat production. Over an equivalent length of time, an increase in the net imports of African countries considerably larger than occurred between 1909–13 and 1921–26 is not unlikely.

Imports of South America

Table 10 shows net imports of wheat and flour by South American countries. In South America there are no countries which during the post-war period at least have shifted from a net importing to a net exporting status; Argentina, Chile, and Uruguay were consistently net exporters, and all other countries were consistently net importers. South American countries imported more wheat and flour than any other continental group in the pre-war period, and were second only to Asia in the post-war period. Brazil is by far the most important single importer; her imports constitute over two-thirds of the total. Peru ranks next in importance. South American imports consist more largely of wheat as grain than those of Asia or Africa. Brazil and Peru are the principal wheat grain importers; other countries except Colombia, whose imports of wheat are much smaller than those of Brazil or Peru, import flour almost exclusively. Throughout South America wheat is used chiefly to make bread of the south European type, not for noodles, boiled or fried doughs, alimentary pastes, or coarse hard bread, as in many parts of Asia and Africa. Hence the South American demand for flour and wheat is chiefly for a fair quality of product for the uses of the wealthier classes of the population, and cheap soft flours or wheats are not preferred in most countries. Also, high grade flours keep better than clears.

Table 10.—Net Imports of Wheat and Flour as Wheat into South American Importing Countries, Pre-War and Post-War*

Calendar year	Total	Brazil	Peru	British Guiana	Venezuela	Others[a]
Average 1909–13..	27,371	21,351	2,121	823	895	2,181
1921.....	23,305	17,353	2,571	763	266	2,352
1922.....	29,081	22,324	2,744	707	820	2,487
1923.....	31,032	22,966	2,810	857	913	3,486
1924.....	38,761	28,830	3,874	803	985	4,270
1925.....	36,614	27,736	3,183	708	1,050	3,937
1926.....	40,269	31,676	3,100	861	1,347	3,284
Average 1921–26..	33,177	25,147	3,047	783	897	3,303

* See Table 6 for sources and qualifying notes.
[a] Bolivia, Colombia, Ecuador, French and Dutch Guiana, Paraguay.

In Brazil the chief cereal foods are wheat, rice, and maize; and manioc or cassava flour is also extensively used. The per capita disappearance of wheat is not large, and appears to have declined from 58 to 53 pounds per annum between the pre-war and post-war periods. Per capita disappearance of rice, on the other hand, rose from 29 to 50 pounds. Disappearance of maize is much larger, as would be expected because of the large livestock population. It is not feasible to ascertain the position of cassava. Brazil raises practically all of her rice, and was a net exporter in four years of the post-war period; but she now produces less than one-sixth of her requirements of wheat. There are said to be considerable areas suitable for wheat production in Brazil, especially in the states of Rio Grande do Sul and Paraná; and recently governmental efforts have been made to encourage domestic production. With wheat readily available in Argentina and Uruguay and the livestock industry already well developed in the potential wheat-growing areas of Brazil, it seems improbable that domestic wheat production will increase with any rapidity. If wheat imports decline, competition with rice seems more likely to prove the effective cause. There are presumably large uncultivated areas suitable for rice production, and per capita consumption of rice appears to be increasing. Nevertheless such decline as there has been in per capita disappearance of wheat has been slight, and would not appear at all for a post-war period excluding 1921, when imports were abnormally small. It seems not to represent a trend of consumption from wheat to rice. There is in Brazil probably a large proportion of the population which would turn from maize and cassava to wheat and rice if circumstances permitted. Hence, even if consumption of rice increases, it may not be at the expense of wheat; and with normal growth of population and economic

prosperity, wheat imports bid fair to continue to increase in the coming years.

Brazil imports the bulk of her wheat and flour from Argentina and Uruguay, the nearest surplus-producing countries. Most of these imports come to Rio de Janiero and other ports lying on the southeastern coast. Some ports on the northeastern coast are near enough to the United States and Canada to permit exporters in those countries to compete regularly; but imports from North America tend to come largely in those months when North American prices are seasonally lowest and Argentine highest.

Whether or not per capita disappearance of wheat has increased in Peru is uncertain in the absence of reliable estimates of population, though there has probably been an increase. Rice and maize are important cereal foods, as in Brazil. Peru produces about as much wheat as she imports, but production seems to increase very slowly. The domestic wheat is milled and consumed where it is produced, in the interior region around the foothills of the Andes. The needs of the coastal region are almost entirely supplied by imports, largely of wheat milled at Callao. Chile naturally dominates the markets of southern Peru, but the United States and Canada compete successfully in the northern regions. With growth of population, further increases in Peruvian net imports are probable.

Among the other importing countries of South America, British Guiana alone imported less wheat and flour in the post-war than in the pre-war period, partly because of the lack of prosperity in the important sugar industry, and perhaps partly because rice, in a population consisting largely of East Indians, has tended to displace wheat. Other countries—Venezuela, Colombia, Bolivia, Ecuador, Paraguay, and French and Dutch Guiana—all imported more wheat and flour after than before the war; and there seems no reason to anticipate a decrease in the total if peaceful development of agriculture and industry continues. Hence, the imports of British Guiana being of small importance, South American imports may be expected to increase, over an equal period of time, at least as rapidly as between the pre-war and post-war periods.

Imports of North and Central America

The net imports of North and Central America (exclusive of Canada and the United States, which are net exporters), averaged 17.5 million bushels, before the war, and 22.2 million in the post-war period. In each period, on the average, flour accounted for all but about 2 million bushels of the average net importations. Of the numerous countries comprising the group, Mexico alone produces wheat in any quantity, though a little is grown in Newfoundland and in the highlands of several Central American countries. Hence North and Central American importing countries are markets for flour to a greater degree even than African countries, and far more so than Asia or South America. As appears from Table 11, no single country is of outstanding importance as an importer. Cuba imported somewhat less than a fourth of the total in both periods, Mexico from a ninth to about a seventh, no other single country as much as a tenth. All countries and dependencies except Newfoundland and certain of the smaller British West Indies imported more wheat and flour after than before the war.

In most of these small markets flour is wanted for the baking of a good quality of white bread, except perhaps in parts of Central America. Bread is not the only staple cereal food, since rice is widely used in most of the West Indian and Central American countries, and to some extent maize. Maize is the staple cereal for the bulk of the population in Mexico, where rice consumption is small. Trends in per capita disappearance of the various cereals differ considerably. In Cuba per capita disappearance of wheat decreased slightly between the pre-war and post-war periods; in Mexico, Porto Rico, Jamaica, and Haiti there were slight increases, and in Trinidad a considerable increase. There was a slight (and probably temporary) decline in per capita disappearance of rice in Mexico, but slight increases in Cuba, Porto Rico, Jamaica, and Trinidad. Per capita disappearance of maize declined in both Cuba and Mexico; in Cuba, however, maize is consumed chiefly by poultry. In the absence of comparable statistics it is not feasible

either to present or to analyze the data bearing on cereal consumption. For the group of North and Central American net importing countries regarded as a unit, there is probably a considerable potential demand for wheat and flour, especially in Mexico and Central America where the bulk of the comparatively large population now consumes maize, and wheat occupies a preferred position. Rice does not distinctly appear to encroach upon wheat flour even where it is most used, in the West Indies. On the whole, if population continues to grow and economic prosperity increases, imports of wheat and flour into the North and Central American group of countries seems likely to increase also, though perhaps no more rapidly than between the pre-war and post-war periods. Mexico alone might conceivably expand her wheat production to meet increased domestic consumption, but is not likely to do so; even if she did, some imports of hard wheat and flour for mixing purposes would still be necessary.

TABLE 11.—NET IMPORTS OF WHEAT AND FLOUR AS WHEAT INTO THE IMPORTING COUNTRIES OF NORTH AND CENTRAL AMERICA, PRE-WAR AND POST-WAR*

(Thousand bushels)

Calendar year	Total	New-foundland	Mexico	Central America[a]	Cuba	Porto Rico	Haiti	British West Indies			Other West Indies		Miscellaneous[d]
								Jamaica	Trinidad and Tobago	Others[b]	French[c]	Dominican Republic	
Ave. 1909–13	17,539	1,769	2,169	2,014	4,321	1,577	1,238	1,223	1,001	1,252	511	341	124
1921 ...	20,134	1,417	4,131	1,850	5,722	1,839	644	1,181	1,261	1,057	484	424	124
1922 ...	20,264	1,905	2,715	2,222	5,485	1,823	1,000	1,303	1,417	1,158	587	504	145
1923 ...	24,253	1,854	4,122	2,561	6,185	2,058	1,626	1,755	1,454	1,245	738	507	148
1924 ...	23,967	1,873	3,243	2,690	6,453	1,966	2,169	1,628	1,352	1,218	703	502	170
1925 ...	21,164	1,598	2,579	2,670	5,950	1,841	1,343	1,329	1,286	1,257	674	475	162
1926 ...	23,373	1,685	4,182	2,800	5,758	1,988	1,472	1,333	1,319	1,250	800	613	173
Ave. 1921–26	22,192	1,722	3,495	2,465	5,925	1,919	1,376	1,422	1,348	1,198	664	504	154

* See Table 6 for sources and qualifying notes.

[a] Costa Rica, Nicaragua, Panama, Canal Zone, Guatemala, Salvador, British Honduras.
[b] Barbados, Bahamas, Bermudas, Caymans, Turks and Caicos, Windward and Leeward Islands.
[c] Guadeloupe, Martinique.
[d] Greenland, Curaçao, St. Pierre and Miquelon.

IMPORTS OF OCEANIA

The imports of the countries of Oceania are comparatively small, amounting, on the average, to less than 3 million bushels in 1921–26 and less than 1.5 million bushels in 1909–13. The data appear in Table 12 (p. 338). Hawaii was the only important importer in the pre-war period, when New Zealand was a net exporter. In the post-war period as a whole, New Zealand was a net importer, and was a net exporter only in 1922 and 1923. These net exports were largely the result of guaranteed prices for a few years following the war; when guarantees were abandoned, acreage and production of wheat in New Zealand declined. Wheat is apparently less remunerative than meat and wool production, and unless government intervention again encourages wheat production, net imports are more likely to remain near the level of 1924–26 than to fall distinctly below.

SUMMARY OF OUTLOOK

We are now in a position to summarize briefly the outlook for expansion of ex-European trade in wheat and flour in the near future. In most net importing countries, imports increased between the pre-war and post-war periods. In the net importing countries of dominant importance—China, Japan, Brazil, and Egypt—per capita disappearance of wheat has apparently increased, and there appears to be a large potential demand for wheat; but the degree to which this will become

effective will depend upon many factors—political, economic, and social. The countries where per capita consumption is clearly declining are few and insignificant.

TABLE 12.—NET IMPORTS OF WHEAT AND FLOUR AS WHEAT INTO THE IMPORTING COUNTRIES OF OCEANIA, PRE-WAR AND POST-WAR*

(Thousand bushels)

Calendar year	Total	New Zealand	Hawaii[a]	Others[b]
Average 1909–13	1,330	[c]	731	598
1921	1,478	306	650	522
1922	1,156	[c]	718	438
1923	1,207	[c]	629	578
1924	4,901	3,547	688	666
1925	4,008	2,641	729	638
1926	4,336	2,969	662	705
Average 1921–26	2,848	1,577	679	592

* See Table 6 for sources and qualifying notes.

[a] Commerce with United States. Imports from other countries are negligible.

[b] French Possessions, Guam, Fiji Islands, New Caledonia, Samoa, Papua. Guam and Samoa are not included because of no data in several years; but imports are small.

[c] Net exports averaged 751 thousand bushels in 1909–13; they were 1,209 thousand in 1922 and 4 thousand in 1923. These are ignored in striking averages and obtaining totals.

With growing population and with increasing per capita consumption of wheat in most countries, net imports must increase unless domestic wheat production expands. This is impossible in many tropical countries such as the West Indies, Central America, much of South America, parts of Africa, the East Indies, and southern Asia. Expansion sufficient to take care of probable increases in consumption seems unlikely to occur in China, Japan, South Africa, Egypt, Brazil, or New Zealand, though in each of these areas and some others, domestic production of wheat could be increased if circumstances justified. Western Asia and French north Africa appear to be the only significant ex-European areas where expansion of domestic production is more likely to exceed than to fall below increasing requirements for consumption; and these areas have never been heavy net importers. Hence one may reasonably anticipate a considerable growth of total ex-European net imports of wheat and flour, whether regular or erratic, in the next decade or more. An average annual increase of 3 to 5 million bushels is not improbable, or at least not so improbable as an increase of 1 or of 10 million bushels, though the complexities of the situation do not warrant a forecast precisely expressed numerically. Total net imports of ex-Europe or net exports to ex-Europe averaging between 160 and 190 million bushels annually may well be recorded in a period of years as distant from 1921–26 as 1921–26 is from 1909–13, say 1933–39.

V. ANNUAL VARIATIONS IN THE TOTAL VOLUME OF TRADE

We have thus far discussed chiefly pre-war and post-war averages either of net import or net export statistics, both of which are computed as far as possible from calendar year data. There are, however, considerable fluctuations in the volume of wheat and flour annually imported into or exported to ex-European net importing countries. Total net exports computed on the calendar year basis varied during the post-war period from 104.6 million bushels in 1921 to 154.4 million in 1924; total net imports computed on the calendar year basis varied from 85.3 million bushels in 1921 to 163.0 million in 1924.[1] The post-war averages, however, differed by less than a million bushels, though the correspondence may be fortuitous. Net exports to ex-Europe averaged 126.3 million bushels, net imports of ex-Europe 127.2 million.

Annual fluctuations in the total volume of ex-European trade must be considered in the process of obtaining a reasonably clear view of the world wheat situation in any current crop year. To assume that ex-European trade of an oncoming crop year will approximate closely the trade of the preceding year or the average of several preceding years is evidently unsound, so large are the variations, at least in calendar year figures. It is desirable to attempt some explanation of recorded annual variations in this ex-European trade, and examination of the prospects for reasonably accurate forecasts of the trade of a current crop year. For such purposes July–June data are more

[1] See Table 2, p. 316, and Table 6, p. 326.

useful than calendar year data, since most analyses of the world wheat situation are presented in terms of Northern Hemisphere crop years. Subsequent discussion concerns data for five years only, 1922–23 to 1926–27. The crop year 1921–22 was abnormal in that trade was affected by disturbances incident to war-time controls, and that China occupied an unusual position as a net exporter while India was a net importer.

Limitations of Crop Year Data

In order to construct annual crop year totals of ex-European net imports of wheat and flour, or of net exports shipped to ex-European countries, one requires either data already presented on the crop year basis for each country, or data presented in monthly or quarterly form. For most importing countries, net import statistics are available only on the calendar year basis. Exports to ex-European destinations from the principal exporting countries, however, can for the most part be obtained on the crop year basis, since data are available in monthly, quarterly, or crop year form. Yet data strictly comparable with the calendar year export data analyzed in a preceding section[1] cannot be secured, principally because exports to ex-Europe from the United States are reported less completely in the monthly trade statistics appearing in the *Monthly Summary of Foreign Commerce* than in the calendar year statistics appearing in *Foreign Commerce and Navigation of the United States.*

The following figures for United States exports to ex-Europe, for five recent calendar years, in million bushels, display the extent of this discrepancy:

Calendar year	*Foreign Commerce and Navigation*	*Monthly Summary of Foreign Commerce*	Discrepancy
1922.....	48.50	42.99	−5.51
1923.....	64.31	60.94	−3.37
1924.....	54.15	49.21	−4.94
1925.....	36.71	30.19	−6.52
1926.....	51.43	43.06	−8.37
Average	51.02	45.28	−5.74

The annual totals obtained from the *Monthly Summary* have fallen below the annual totals obtained from *Foreign Commerce and Navigation* by amounts varying from 3.37 million bushels to 8.37 million, and averaging 5.74 million. This apparently arises from the fact that small exports to a large number of countries are not given in detail in the *Monthly Summary,* but are grouped, together with exports to ex-European countries which are not net importers, under the heading "other countries." Only 15 ex-European importing countries or groups are specified in the *Monthly Summary,* whereas 57 are specified in *Foreign Commerce and Navigation.* Hence the crop year totals of net exports to ex-European net importing countries subsequently shown in the present section must be too low by around 6 million bushels on the average.

There is no difficulty involved in obtaining exports from Australia and Canada to ex-Europe on a July–June basis; these are obtained from the same quarterly or monthly data employed in a preceding section in constructing calendar year totals. July-June exports from Argentina, however, must be secured from monthly data appearing in *Estadistica Agro-Pecuaria,* while calendar year exports are obtained from the *Annuario del Comercia Exterior.* These sources show some discrepancies, though not important ones.[2] Total crop year (July–June) exports to ex-European importing countries include the exports not only of Australia, Argentina, the United States, and Canada, but also of India and Chile. But Indian exports are necessarily compiled on an April–March, not a July–June, crop year, and Chilean crop year exports can only be approximated by averaging exports to ex-Europe in two successive calendar years. Since Indian and Chilean exports are small, the July–June crop year totals are not greatly in error because of this procedure. There are, furthermore, some estimates—of Indian total

[1] See pp. 315–25.

[2] The following data show Argentine exports to ex-European net importing countries for the four calendar years 1922–25, in million bushels:

	Annuario del Comercia Exterior	*Estadistica Agro-Pecuaria*
1922	17.95	16.45
1923	18.00	19.39
1924	21.28	22.43
1925	19.06	19.18
Average	19.07	19.36

exports in 1925–26 and 1926–27, of Chilean total exports in 1926–27, and of exports from the United States to "other South America" in 1922–23 and 1923–24; but the bases for these small estimates are reasonably sound, and the errors introduced by them must be small.

On the whole, therefore, our imperfect totals of crop year exports to ex-European net importing countries seem to approximate the truth fairly closely for each of the crop years 1922–23 to 1926–27. In each year the totals are too small, partly because exports from the United States are understated, but partly because exports from Uruguay, Eritrea, and in some years from countries in Asia Minor are not included. All in all, the understatement in some years may amount to as much as 15 million bushels, and is probably never less than 5 million. Nevertheless, in the present state of statistical information, these totals appear to display annual variations in ex-European trade by crop years better than any other available series.

Comparisons with Broomhall's Data

The most familiar and widely used estimates of ex-European trade during crop years are those published in Broomhall's *Corn Trade News*. In his *Corn Trade Year Book* Broomhall also publishes revised estimates of total world shipments of wheat and flour, and total shipments to Europe; and by subtraction shipments to ex-Europe can be obtained from these. The following figures, in million bushels, show for crop years 1922–23 to 1926–27 our figures for exports from the principal exporting countries to ex-European net importing countries in comparison with Broomhall's shipments data:

Crop year	Exports	Shipments	
		Corn Trade News	*Corn Trade Year Book*
1922–23	104.8	90.5	89.3
1923–24	172.5	148.8	146.8
1924–25	108.9	75.5	90.7
1925–26	128.2	135.3	135.3
1926–27	128.5	132.0	131.5
Average	128.6	116.4	118.7

The three sets of data are not strictly comparable, if only because Broomhall's figures are for August–July crop years, whereas the export data are predominantly for July–June crop years. Nevertheless, if shipments are assumed to include all shipments of wheat and flour from all points to all ex-European destinations, including India, shipments ought to exceed these export totals since, as we have pointed out, the export figures here presented are below the truth. Hence one can only conclude that Broomhall's estimates of ex-European trade were much too low in 1922–23, 1923–24, and 1924–25, though only slightly so in 1925–26 and 1926–27. With respect to displaying annual variations in total ex-European trade the three sets of data do not always agree. Trade appears smallest in 1922–23 on the basis of export and Broomhall's *Year Book* data, but in 1924–25 on the basis of *Corn Trade News* figures.[1] Otherwise there is rough agreement: trade was smallest in 1922–23 and 1924–25, largest in 1923–24, and moderately large in 1925–26 and 1926–27.

The evidence therefore suggests that Broomhall's data, at least for earlier years, cannot be accepted as indicating the volume of ex-European trade with reasonable accuracy. Understatements of at least 14 million bushels in 1922–23, 24 million bushels in 1923–24, and 18 million bushels in 1924–25 are too large to be ignored, especially since understatement is not consistent and hence cannot be allowed for in analysis of current crop year estimates. As far as we are able to judge in the absence of detailed information respecting the manner in which Broomhall's data are collected and revised, export data seem to represent the annual crop year volume of ex-European trade much more satisfactorily, even though the figures are somewhat too low in all years.

Causes of Annual Variation

Annual variations in the volume of exports to ex-European net importing countries may be due to a great variety of causes.

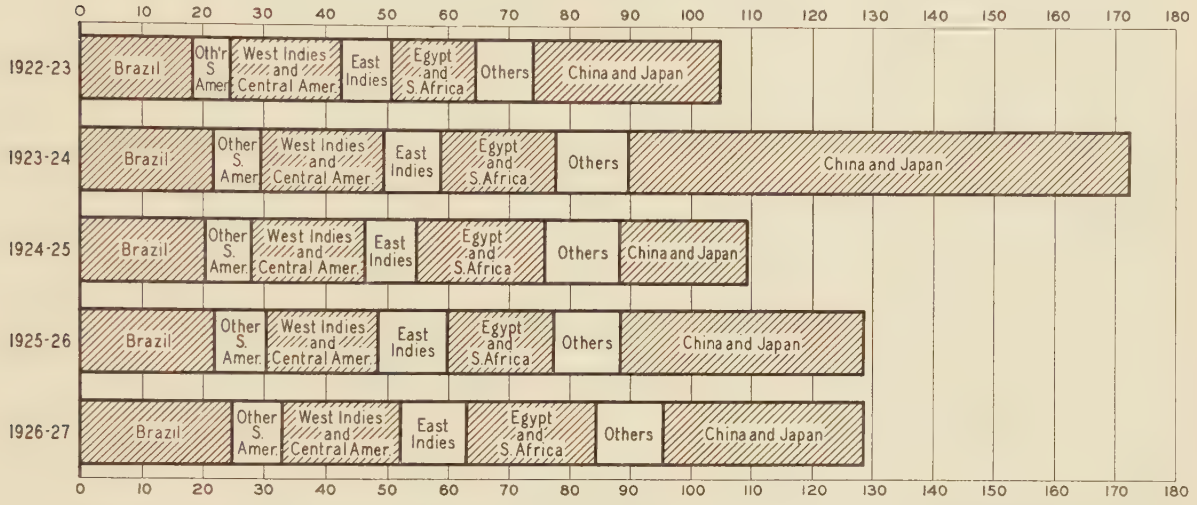
[1] We have no basis for explaining the differences between *Corn Trade News* and *Corn Trade Year Book* figures. The upward revision of shipments to ex-Europe in 1924–25, from 75.5 to 90.7 million bushels, is especially interesting.

With a rising trend in net imports, the broad tendency is for trade to be larger each year than it was the year before; an annual increment may be added because of growth in population and/or per capita consumption in importing countries. Trade might be expected to prove relatively large in years when wheat and flour prices are low, and relatively small when prices are high. Some ex-European countries produce more wheat than they import; and the imports of these countries might be expected to be large when domestic crops are short, small when domestic supplies are plentiful. Other countries produce little or no wheat; but imports of wheat and flour may perhaps be affected by production and relative prices of cereals with which wheat competes, or of commodities from which these countries obtain the major proportion of their national income. Ex-European countries are both numerous and widely different with respect to the factors which govern imports of wheat and flour; and adequate statistical data bearing on these factors are frequently lacking. Hence the causes of annual fluctuations in imports of or exports to particular countries and ex-Europe as a whole cannot always be ascertained.

Chart 2 shows total exports to ex-Europe from the six principal exporting countries distributed to the principal countries (or groups of countries) of destination. In 1922–23 total exports of 105 million bushels were smallest, though but slightly larger than in 1924–25; in 1923–24 the total of 172 million bushels was by far the largest; and in both 1925–26 and 1926–27 exports reached nearly 130 million bushels. The extreme variation thus was 67 million bushels, between 1922–23 and 1923–24. Variations in exports to China and Japan clearly account for most of the variation in total exports. These ranged from 20.6 million bushels in 1924–25 to 82.6 million in 1923–24. If exports to China and Japan are excluded, the totals to all other countries varied only from 74 million bushels in 1922–23 to 95 million in 1926–27, or 21 million bushels. This amount of variation, occuring as it does between the earliest and latest years of the period, may reasonably be accounted for in large part by normal growth in trade due to increase of population and per capita consumption of wheat. But the fact that normal growth is not the only cause of variations in exports of all countries (excluding China and Japan) is suggested by the fact that in the three years 1923–24 to 1925–26 exports to this group were of very nearly

CHART 2.—NET EXPORTS OF WHEAT AND FLOUR (AS WHEAT) FROM PRINCIPAL EXPORTERS TO PRINCIPAL EX-EUROPEAN DESTINATIONS, ANNUALLY, 1922–23 TO 1926–27*

(Million bushels)



* Summarized from data in official trade reports of the United States, Canada, Argentina, Australia, India, and Chile. Includes some estimates, especially for Chile and India. See text, pp. 339–40, for further description of the data used.

the same size, not larger in each successive year.

At first glance the chief cause of variation in total ex-European trade would appear to be relative variations in wheat prices. Table 13 shows various significant annual prices of wheat compared with the total exports to ex-Europe as recorded. These exports contain an annual increment of growth, due to increase of population and per capita consumption, which seems to approximate 4 million bushels. Wheat prices were distinctly low in 1923–24, and not much higher in 1922–23; they were distinctly high in 1924–25, little if any lower in 1925–26, and (at least in exporting countries) again considerably lower in 1926–27, though not so low as in 1922–23.[1]

If prices alone determined the volume of ex-European trade, one would expect exports to have been largest in 1923–24, and smallest in 1924–25, and so indeed they were, even after allowance for normal growth. That exports of 1925–26 would be slightly larger than those of 1924–25 is also in accord with expectations. But one would not expect imports of 1922–23 to be so much smaller than in 1923–24, or any smaller than in 1925–26 and 1926–27; and one would expect the 1926–27 imports to be larger, not smaller, than those of 1925–26.

TABLE 13.—COMPARISONS OF TOTAL EXPORTS OF WHEAT AND FLOUR AS WHEAT TO EX-EUROPEAN DESTINATIONS WITH ANNUAL AVERAGE WHEAT PRICES, 1922–27*

Year	Total exports to ex-Europe (Million bushels)	British customs prices (Dollars per bushel)	U.S. farm prices (Dollars per bushel)	Washington farm prices (Dollars per bushel)	Alberta farm prices (Dollars per bushel)	Winnipeg No. 3 Man. (Dollars per bushel)	Australian f.o.b. prices (Dollars per bushel)	Argentine Barletta cash prices (Dollars per bushel)
1922–23	105	1.38	.98	1.02	.77	1.06	1.18	1.19
1923–24	172	1.22	.92	.86	.65	.97	1.02	1.06
1924–25	109	1.77	1.28	1.44	1.20	1.59	1.44	1.66
1925–26	128	1.70	1.46	1.34	1.19	1.42	1.49	1.66
1926–27	128	1.64	1.23	1.19	1.05	1.35	1.29	1.44

* Export figures from official trade reports of the principal exporting countries. British prices derived from data in *Accounts Relating to Trade and Navigation of the United Kindgom;* United States prices from *Agriculture Yearbook, 1927,* p. 756, and *Crops and Markets;* Canadian prices from *Monthly Bulletin of Agricultural Statistics,* and *Report on the Grain Trade of Canada;* Argentine prices from International Institute of Agriculture; Australian prices from unofficial source. Averages for crop years August–July, except United States prices which are July–June averages.

In considerable part the explanation of these divergencies of actual exports from what would be roughly expected from the price situation are to be found in particular aspects of the Japanese and Chinese wheat situations. Exports to China, to Japan, to other ex-Europe, and to all ex-Europe were as follows, in million bushels:

Crop year	China	Japan	China and Japan	All other	Total ex-Europe
1922–23	17.0	14.1	31.1	73.7	104.8
1923–24	50.5	32.1	82.6	89.9	172.5
1924–25	5.7	15.0	20.7	88.2	108.9
1925–26	10.5	29.6	40.1	88.1	128.2
1926–27	12.9	20.2	33.2	95.3	128.5

The huge exports to China in 1923–24 largely account for the heavy total exports to ex-Europe in that year. But these were not due solely to low world wheat prices. The wheat crop of north Manchuria was distinctly short;[2] hence the requirements of south Manchuria could not be met from that source. Nor, apparently, could they be obtained from other Chinese regions.

[1] It is not pertinent here to explain in detail why each price series does not show the same changes in price levels. British prices were higher relative to export prices in 1926–27 than they would have been in the absence of a great bulge in ocean freight rates. United States prices were relatively high in 1925–26 following a short domestic crop accompanied by tariff protection. Australian prices would have shown more difference between 1924–25 and 1925–26 had not the Australian crop of 1924 been exceptionally large, that of 1925 rather small.

[2] North Manchurian crops for 1922–26 were estimated by the Chinese Eastern Railway, in million bushels, as follows:

1922	45	1925	22
1923	19	1926	24
1924	21		

See U. S. Department of Agriculture, *Foreign News on Wheat,* November 7, 1927, p. 5. Cf. data given above, pp. 331–32.

Although no statistics are available, it appears that the Chinese wheat crop of 1923 was unusually small.[1] The Japanese crops both of rice and of wheat were the smallest of the period.[2] These circumstances, as well as low wheat prices, may reasonably be supposed to have contributed to the heavy exports to China and Japan in 1923–24, and hence to the large total of ex-European trade.

In 1924–25, when wheat prices were highest, Japanese and Chinese imports combined were lower than in any other year of the period. Exports to China, only 5.7 million bushels, were particularly small. In this year, however, the Chinese wheat crop, though not the Manchurian, appears to have been good,[3] and imports as heavy as those of 1923–24 would probably not have occurred even if foreign wheat prices had been equally low. There appears also to have been an unusually heavy carryover of import wheat out of 1923–24.

The fact that exports to China and Japan were somewhat larger in 1925–26 than in 1926–27 despite higher prices is not easily explained. Japan had a good wheat crop in both years; the Chinese situation, particularly with respect to the effects of internal warfare, is far from clear. It is to be observed, however, that exports to China were larger in 1926–27 than in 1925–26, while exports to Japan were smaller. Japanese millers purchased wheat rather heavily in 1925–26 partly in order to anticipate an increase in the duty which took effect on March 29, 1926. Except for this occurrence, it is possible that exports to China and Japan combined would have been larger in 1926–27 than in 1925–26, as would accord with the price situation in these two years.

The effect of these various circumstances was apparently to swell total ex-European exports considerably in 1923–24, to reduce them somewhat in 1924–25; and to swell them slightly in 1925–26, and to reduce them slightly in 1926–27. It is of course impossible to make precise numerical allowances for these influences. Presumably 1923–24 would still appear as the year of largest ex-European trade. But 1926–27 would more clearly appear next largest, 1925–26 next, 1924–25 next, and 1922–23 smallest. If so, one might reasonably conclude that only large changes in wheat prices are sufficient to alter the volume of ex-European trade from what might be expected if an increment is added each year on account of growth of consumption. Apparently ex-European demand for wheat is not to be described as distinctly elastic. Wheat production in the importing countries remaining about the same from year to year, and wheat prices changing only by 10 or 15 per cent, total exports to ex-Europe would probably differ little between any two successive years; and differences between years separated by a considerable period would be due predominantly to increase in consumption.

The limited elasticity of ex-European demand is further indicated by annual variations in exports to those countries which produce little or no wheat. Chart 2 (p. 341) shows roughly the sums of exports to such countries—Brazil, other South America, the West Indies and Central America, and the East Indies. These sums were as follows in relation to total exports to ex-Europe, in million bushels:

	Exports to countries specified above	Exports to all ex-Europe
1922–23	51.0	104.8
1923–24	58.8	172.5
1924–25	54.8	108.9
1925–26	59.6	128.2
1926–27	62.9	128.5

Fairly regular growth is the outstanding feature of exports to these predominantly non-wheat-producing countries, interrupted only by exceptionally heavy exports in 1923–24, the year of distinctly low prices. Far higher prices apparently did not serve greatly to curtail imports in 1924–25 and 1925–26. It seems fairly clear that exports

[1] *Ibid.*, February 9, 1928, p. 6.

[2] Japanese Empire wheat crops in million bushels and rice crops in billion pounds were as follows:

	Wheat	Rice
1922–23	39.2	25.5
1923–24	35.2	23.7
1924–25	37.3	24.0
1925–26	40.0	25.4
1926–27	39.9	24.2

[3] U.S. Department of Agriculture, *loc. cit.* There is no reason to suppose that the total Chinese wheat crop varies with the north Manchurian. The small Manchurian crop of 1923 was due to a crop failure; that of 1924 and subsequent years to a reduction of acreage following this failure.

to this group of countries cannot be expected to vary widely in accordance with variations in wheat prices. Exceptionally high or low prices seem to cause only slight variations in imports; and the element of growth is apparently the dominant influence. As far as Cuba—the most important single importer of the group after Brazil—is concerned, imports seem to depend quite as much upon domestic production and prices of sugar as upon wheat or flour prices.[1] Cuba is a one-crop country, and her imports of flour are in part dependent upon general prosperity which rests on sugar; but the variation in net exports to Cuba is very slight.

Little is to be gained by discussing exports to Egypt; exports to Egypt do not coincide even roughly with crop year net imports. Difficulties arise because Egypt is a country of transhipment, and because wheat and flour shipped to orders from Australia and India, of which we have taken no acount, may have Egypt as the country of final destination. There seems to be no well-marked concordance between Egyptian net imports and Egyptian wheat crops, or between imports and prices. But the annual variations in net imports are small, and in exports to Egypt not large. Exports to South Africa, apparently depend more upon domestic wheat production than upon wheat prices; imports were largest in 1923–24, when the domestic crop was smallest, and smallest in 1926–27, when the domestic crop was large.[2] Fluctuations in domestic production are also significant in New Zealand, where distinctly small crops in 1923–25 led to proportionately large imports.[3]

The dominant causes of annual variations in the total volume of ex-European trade thus appear to be (1) annual growth of consumption common to the majority of ex-European countries; (2) annual fluctuations in the domestic wheat crops of certain wheat-producing countries, especially China; and (3) the annual variations in wheat prices. The evidence suggests that among these influences the third, often regarded as the most important, is not in fact so, but is subordinate to the second. Since these factors account fairly well for variations in ex-European trade, the substitution for wheat of available supplies of cereal foods such as rice in the Orient or maize in Central and South America appears not to be of great importance, though supplies and prices of substitutes presumably have some effect.

Forecasting the Volume of ex-European Trade

From the foregoing pages it is perhaps apparent that the problem of forecasting the probable volume of ex-European trade in a given crop year must remain a difficult one. Yet some help may be gained from the conclusions that demand in many countries is not highly elastic, and that consumption may be expected to increase fairly steadily. Moreover, if the list of ex-European net importing countries does not change—if some countries which usually export wheat do not in particular years become net importers—then the size of the Chinese wheat crop appears to be the most important single influence on the total volume of trade, and after it, the level of wheat prices. If one wishes to forecast "requirements," the level of prices ought not to enter into the calculation; but this may properly be considered in forecasting the probable volume of trade.

As we have seen, statistics indicating the volume of exports to ex-European countries are affected by the price situation in various years; and it is impossible to de-

[1] Exports of wheat and flour to Cuba, in million bushels, in relation to values of the Cuban sugar crops, in million dollars (as given in *Commerce Yearbooks*), for 1922–23 to 1926–27, were as follows:

	Wheat imports	Sugar crop values
1922–23	6.19	400.2
1923–24	6.35	368.5
1924–25	6.31	273.2
1925–26	6.12	245.3
1926–27	6.00	280.7

[2] Exports to the Union of South Africa compare as follows with domestic wheat crops, both in million bushels:

	Exports	Crops
1922–23	5.05	6.3
1923–24	6.79	6.0
1924–25	5.96	7.1
1925–26	4.79	7.8
1926–27	3.67	9.0

[3] Exports to New Zealand were negligible in 1922–23, when the wheat crop harvested early in 1922 reached 10.6 million bushels; but following the small crops harvested in 1923–25, which ranged from 4.2 to 5.4 million bushels, exports to New Zealand ranged from 2.4 to 3.1 million bushels.

termine what exports would have been had prices remained unchanged from year to year. Forecasting must rest on some sort of a record of past occurrences. In order to forecast "necessary" or "customary" requirements of ex-Europe, one desires a record of exports as they would have appeared if uninfluenced by prices; but no such record is obtainable. Alternatively, however, one may regard total exports in 1924–25 as minimum requirements of ex-Europe; this was the post-war year of highest prices, and a year in which China appears to have had a distinctly good wheat crop.

Even in the absence of any notion whether the Chinese crop is large or small in the year for which ex-European requirements are to be forecast, one could under most circumstances assume that minimum ex-European requirements would exceed those of 1924–25 at least by an amount equal to 3 or 4 million bushels multiplied by the number of years in the interval between 1924–25 and the current crop year. This assumption would be unsound in the event of higher prices than those of 1924–25; but the distribution of world crops and the level of prices in 1924–25 may properly be regarded as quite unusual. Moreover, more or less tangible evidence respecting the size of the Chinese crop would probably be available in the period when the forecast is made, presumably in September–December; for this crop is harvested earlier than the winter-wheat crop of the United States, and comes to market in volume by June. Merely with the assurance that the Chinese crop was distinctly short, distinctly good, or about average, one could make reasonable though not exact numerical allowances for exports to China, and could add these to the sum previously obtained. The result would be a forecast somewhat more reasonable than otherwise seems possible with present information. If based upon the export data employed above, it would be a forecast of incomplete, not total, exports to ex-Europe, too low at least by the amount that United States exports reported monthly fall below annually reported figures; and even with an allowance for this understatement, the forecast would be too low because it would apply only to exports from the six principal exporting countries.

Each year the possibility that India and perhaps Algeria and Tunis might become net importers would need to be borne in mind. But the prospects of such occurrences may be expected to become fairly clear by the time when a forecast is to be made, and reasonable allowances are not impossible. Having reviewed these factors, one would be in a position to say that the requirements of ex-Europe must reach at least a certain figure; and that this figure compares in a certain way with recorded exports in past years, and has a certain signifiance with respect to world wheat prices. In connection with other data, notions respecting the probable extent of world demand for wheat in the current crop year could be somewhat clarified, though by no means rendered exact.

If probable exports to ex-Europe rather than minimum requirements of ex-Europe were to be forecast, allowance would need to be made for additional exports due to differences of prices in 1924–25 and in a current year. At present it seems necessary that such allowances be made by judgment, not by statistical formulas. Eventually, after a longer series of trustworthy trade statistics has been accumulated and more has been learned about production and consumption of wheat, it may become possible to measure and forecast with some precision both European and ex-European minimum requirements, and to distinguish these sharply from actual exports to Europe and ex-Europe. But at present the data permit only the roughest approximations.

This study is the work of M. K. Bennett, with substantial assistance from Margaret Milliken and Janet Murray

APPENDIX

TABLE I.—UNITED STATES EXPORTS OF WHEAT AND FLOUR (AS WHEAT) TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR*

(Million bushels)

Area	1909–10	1910–11	1911–12	1912–13	1913–14	Pre-war average	1921	1922	1923	1924	1925	1926	Post-war average
North and Central America	14.52	12.42	14.55	15.03	13.48	14.00	16.67	16.24	19.23	19.60	16.04	18.74	17.76
Newfoundland	.29	.34	.17	.38	.45	.33	.09	.11	.07	.20	.11	.23	.13
Mexico	3.32	.42	1.58	.75	.44	1.30	4.32	2.91	4.13	3.05	2.32	2.85	3.26
Central America[a]	1.96	2.27	2.51	2.86	2.77	2.47	2.52	2.92	3.54	4.70	2.97	5.32	3.66
Cuba	3.73	3.99	3.98	4.31	4.25	4.05	5.04	5.14	5.16	5.68	5.66	5.26	5.32
Porto Rico	1.53	1.63	1.56	1.67	1.59	1.60	1.65	1.86	2.07	1.98	1.85	2.00	1.90
Haiti	.78	.86	1.53	1.36	.99	1.10	.65	1.04	1.79	1.65	1.13	1.26	1.25
British West Indies	2.18	2.04	2.28	2.66	2.02	2.23	1.31	1.09	1.18	1.12	.89	.70	1.05
Jamaica	....	.75	.80	1.18	.93	.91	.92	.73	.88	.76	.67	.53	.75
Trinidad and Tobago	....	.57	.71	.64	.34	.57	.11	.08	.03	.07	.03	.04	.06
Others[b]	....	.71	.77	.84	.75	.77	.28	.28	.27	.29	.18	.13	.24
Other West Indies	.72	.86	.94	1.03	.96	.90	1.09	1.22	1.30	1.23	1.10	1.12	1.18
French	.25	.33	.39	.43	.45	.37	.44	.49	.68	.60	.46	.35	.50
Dominican Republic	.27	.31	.31	.38	.33	.32	.42	.48	.39	.39	.42	.54	.44
Others[c]	.19	.22	.24	.22	.18	.21	.23	.24	.24	.24	.22	.23	.23
Miscellaneous[d]	.01	x	x	.01	.01	.01	x	x	x	x	x	x	x
South America	4.40	5.59	6.00	5.98	6.07	5.61	5.28	4.23	4.07	5.55	6.25	11.45	6.14
Brazil	1.69	2.44	2.94	2.74	3.52	2.67	2.88	2.00	2.18	2.98	3.56	7.56	3.53
Peru	.84	.97	.61	.63	.58	.73	1.21	.77	.47	.63	.39	1.30	.79
British Guiana	.52	.54	.57	.51	.26	.48	.05	.03	.02	.01	.02	.01	.02
Venezuela	.57	.66	.82	.98	.75	.76	.55	.39	.29	.35	.59	.67	.47
Others[e]	.78	.97	1.07	1.12	.96	.98	.60	1.05	1.11	1.59	1.70	1.91	1.33
Asia	5.82	11.44	16.07	16.82	15.51	13.13	18.71	23.41	38.19	26.57	11.35	17.12	22.56
Ceylon	....	....	....	....	....	....	....	....	x	....	....	....	x
China[f]	3.24	6.15	10.53	6.72	6.00	6.53	5.87	11.55	25.84	15.24	4.62	5.77	11.48
Japanese Empire[g]	1.15	4.21	4.08	8.32	8.36	5.22	10.07	9.33	9.78	7.88	3.85	8.09	8.17
Dutch East Indies	....	....	....	....	....	....	.05	x	x	....	....	x	.01
Philippines	1.18	1.07	1.45	1.74	1.11	1.31	1.20	1.95	2.37	3.30	2.65	2.74	2.37
Western Asia[h]	x	x	x	x	x	x	1.29	.34	.18	.07	.21	.16	.38
Indo-China	....	....	....	....	....	....	....	x	....	x	x	x	x
Others[i]	.24	.02	.01	.04	.03	.07	.23	.23	.02	.08	.02	.35	.16
Africa	.79	.61	.50	2.78	1.10	1.15	3.03	3.75	2.09	1.62	2.23	3.11	2.64
Egypt and Sudan	.04	.30	.14	.28	.26	.20	.71	1.07	1.14	.66	1.21	1.89	1.11
Union of South Africa	.08	.05	.05	.26	.12	.11	.02	.02	.05	.02	.06	.09	.04
Other British Africa[j]	.14	.20	.23	.34	.43	.27	.24	.37	.52	.70	.66	.65	.52
French Africa[j]	.07	.02	.02	1.81[k]	.17	.42	1.94[k]	1.64[k]	.06	.09	.09	.07	.65
Others[l]	.46	.04	.06	.09	.11	.15	.11	.66	.31	.16	.22	.41	.31
Oceania	.65	.72	.82	.87	.91	.79	.68	.81	.73	.81	.83	1.02	.81
New Zealand	....	....	x	....	....	x	x	x	x	....	x	.24	.04
Hawaii	.55	.63	.71	.75	.79	.69	.62	.72	.63	.69	.73	.66	.68
Others[m]	.10	.09	.11	.12	.13	.11	.06	.08	.10	.11	.09	.11	.09
Total	26.18	30.78	37.95	41.47	37.07	34.69	44.37	48.50	64.31	54.15	36.71	51.43	49.91

* Data from *Foreign Commerce and Navigation of the United States.* Pre-war data for July–June years; post-war data for calendar years. Flour converted to wheat at 4.7 bushels per barrel. Dots (....) indicate years when no exports were reported to designated destinations. Exports of less than 5,000 bushels are indicated by "x."

[a] British Honduras, Costa Rica, Honduras, Guatemala, Panama, Salvador, Nicaragua.

[b] Bermudas, Barbados, other British West Indies.

[c] Dutch West Indies, Virgin Islands.

[d] St. Pierre and Miquelon.

[e] Bolivia, Colombia, Ecuador, Dutch Guiana, French Guiana, Paraguay.

[f] Including Hongkong and Kwantung.

[g] Japan, Chosen.

[h] For pre-war years Asiatic Turkey alone; for post-war years Palestine, Syria, Armenia, Kurdistan, Turkey in Asia, Asiatic Greece, Aden.

[i] Straits Settlements, Siam, Asiatic Russia, Far Eastern Republic, British Malaya.

[j] Precise destinations not ascertainable.

[k] Probably includes exports to Algeria and Tunis in 1912–13 and 1921, and certainly in 1922.

[l] Portuguese Africa, Canary Islands, Liberia, German and Spanish Africa, Italian possessions, Mozambique, Belgian Congo.

[m] British Oceania, French Oceania, other Oceania.

TABLE II.—UNITED STATES EXPORTS OF WHEAT TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR*

(Million bushels)

Area	1909–10	1910–11	1911–12	1912–13	1913–14	Pre-war average	1921	1922	1923	1924	1925	1926	Post-war average
North and Central America	3.20	.32	1.55	.80	.50	1.27	3.01	2.03	3.00	3.60	1.76	4.83	3.04
Newfoundland	x	....	....	x	....	x	x	....	x	.10	....	.06	.03
Mexico	3.18	.27	1.47	.62	.22	1.15	2.66	1.52	2.08	1.46	1.38	1.92	1.84
Central America[a]	.01	.04	.05	.13	.21	.09	.30	.49	.88	1.95	.34	2.71	1.11
Cuba	.01	.01	.02	.05	.05	.03	.01	.02	.03	.09	.03	.09	.05
Porto Rico	x	x	....	....	....	x	....	....	....	....	....	....	....
Haiti	x	....	x	x	.01	x	x	x	x	x	....	....	x
British West Indies	x	x	x	x	x	x	x	x	x	.01	x	x	x
Jamaica	....	....	x	x	x	x	x	x	x	x	x	x	x
Trinidad and Tobago	....	....	x	....	....	x	....	....	....	....	....	....	....
Others[b]	....	x	x	x	x	x	x	x	x	.01	x	x	x
Other West Indies	x	x	x	x	x	x	.03	x	x	.01	.01	.05	.02
French	....	....	....	....	....	....	....	....	x	....	....	....	x
Dominican Republic	x	x	x	x	x	x	.03	x	x	.01	.01	.05	.02
Others[c]	....	....	....	....	....	....	x	....	x	....	....	....	x
South America	.45	.32	.52	.58	.25	.42	2.67	.38	.12	.47	.20	4.09	1.32
Brazil	x	x	x	x	x	x	1.66	x	x	x	x	3.12	.80
Peru	.33	.08	.19	.19	.02	.16	.96	.29	.02	.31	....	.76	.39
British Guiana	....	....	....	....	....	....	....	....	x	....	....	....	x
Venezuela	....	....	x	x	x	x	x	x	x	x	x	x	x
Others[c]	.12	.24	.33	.39	.23	.26	.05	.09	.10	.16	.20	.22	.14
Asia	.13	2.10	.74	4.18	4.63	2.36	9.40	9.39	15.06	9.64	4.08	9.05	9.44
China[f]	....	.06	.03	....	x	.02	1.17	1.61	6.52	2.25	.39	.80	2.12
Japanese Empire[g]	.13	2.05	.71	4.18	4.63	2.34	8.22	7.59	8.54	7.30	3.67	8.01	7.22
Philippines	....	....	....	....	....	....	....	....	....	....	x	....	x
Western Asia[h]	x	x	x	x	x	x	x	x	x	x	.02	.01	.01
Others[i]	....	....	....	....	....	....	....	.18	x	.08	....	.23	.08
Africa	.50	.11	x	1.99	.25	.57	1.96	1.67	x	x	.01	.35	.67
Egypt and Sudan	x	.11	....	....	....	.02	.04	....	....	....	....	.28	.05
Union of South Africa	.04	....	x	.19	.09	.07	.02	....	x	x	.01	.07	.02
Other British Africa[j]	....	....	....	....	....	....	....	....	x	....	....	....	x
French Africa[j]	.05	....	....	1.79[k]	.16	.40	1.91[k]	1.59[k]	....	....	....	....	.58
Others[i]	.41	....	....	....	x	.08	....	.08	x	x	x	x	.01
Oceania	.07	.08	.11	.11	.13	.10	.07	.07	.09	.10	.08	.31	.12
New Zealand	....	....	....	....	....	....	....	....	x	....	....	.24	.04
Hawaii	.07	.07	.10	.11	.13	.10	.07	.07	.09	.10	.08	.07	.08
Others[m]	x	x	x	x	x	x	x	x	x	x	x	x	x
Total	4.35	2.93	2.92	7.66	5.76	4.72	17.11	13.54	18.27	13.82	6.14	18.62	14.58

* For sources and footnotes, see Appendix Table I.

TABLE III.—UNITED STATES EXPORTS OF FLOUR (AS WHEAT) TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR*

(Million bushels)

Area	1909–10	1910–11	1911–12	1912–13	1913–14	Pre-war average	1921	1922	1923	1924	1925	1926	Post-war average
North and Central America	11.32	12.10	13.00	14.22	12.98	12.72	13.66	14.26	16.24	15.99	14.28	13.91	14.72
Newfoundland	.29	.34	.17	.38	.45	.33	.09	.11	.07	.10	.11	.17	.11
Mexico	.13	.15	.11	.12	.22	.15	1.66	1.39	2.05	1.59	.94	.93	1.43
Central America[a]	1.95	2.23	2.45	2.73	2.56	2.39	2.22	2.43	2.65	2.75	2.64	2.61	2.55
Cuba	3.72	3.98	3.96	4.27	4.20	4.02	5.02	5.12	5.13	5.59	5.63	5.16	5.28
Porto Rico	1.53	1.63	1.56	1.67	1.59	1.60	1.65	1.86	2.07	1.98	1.85	2.00	1.90
Haiti	.78	.86	1.53	1.36	.98	1.10	.65	1.04	1.79	1.65	1.13	1.26	1.25
British West Indies	2.18	2.04	2.28	2.65	2.02	2.23	1.31	1.09	1.18	1.11	.89	.70	1.05
Jamaica	....	.75	.80	1.18	.93	.91	.92	.73	.88	.76	.67	.53	.75
Trinidad and Tobago	....	.57	.71	.64	.34	.57	.11	.08	.03	.07	.03	.04	.06
Others[b]	....	.71	.77	.84	.75	.77	.28	.28	.27	.28	.18	.13	.24
Other West Indies	.72	.86	.94	1.03	.96	.90	1.05	1.22	1.30	1.22	1.08	1.07	1.16
French	.25	.33	.39	.43	.45	.37	.44	.49	.68	.60	.46	.35	.50
Dominican Republic	.27	.31	.31	.38	.33	.32	.38	.48	.39	.38	.41	.49	.42
Others[c]	.19	.22	.24	.22	.18	.21	.23	.24	.24	.24	.22	.23	.23
Miscellaneous[d]	.01	x	x	.01	.01	.01	x	x	x	x	x	x	x
South America	3.95	5.27	5.49	5.41	5.81	5.18	2.61	3.85	3.95	5.08	6.05	7.35	4.81
Brazil	1.69	2.44	2.94	2.74	3.52	2.67	1.23	2.00	2.18	2.98	3.56	4.44	2.73
Peru	.51	.90	.42	.44	.56	.56	.24	.47	.45	.32	.39	.54	.40
British Guiana	.52	.54	.57	.51	.26	.48	.05	.03	.02	.01	.02	.01	.02
Venezuela	.57	.66	.82	.98	.75	.76	.55	.39	.28	.35	.59	.67	.47
Others[e]	.66	.73	.75	.73	.73	.72	.55	.96	1.01	1.42	1.50	1.69	1.19
Asia	5.69	9.33	15.33	12.64	10.89	10.78	9.31	14.02	23.13	16.93	7.27	8.07	13.12
Ceylon	....	....	....	....	....	....	....	....	x	....	....	....	x
China[f]	3.24	6.09	10.50	6.72	6.00	6.51	4.70	9.93	19.32	12.98	4.22	4.98	9.36
Japanese Empire[g]	1.03	2.16	3.37	4.14	3.74	2.89	1.84	1.75	1.24	.58	.18	.08	.94
Dutch East Indies	....	....	....	....	....	....	.05	x	x	....	....	x	.01
Philippines	1.18	1.07	1.45	1.74	1.11	1.31	1.20	1.95	2.37	3.30	2.65	2.74	2.37
Western Asia[h]	x	x	x	x	x	x	1.29	.34	.18	.06	.20	.15	.37
Indo-China	....	....	....	....	....	....	....	x	....	x	x	x	x
Others[i]	.24	.02	.01	.04	.03	.07	.23	.05	.01	x	.02	.12	.07
Africa	.29	.50	.50	.79	.85	.58	1.07	2.08	2.09	1.62	2.22	2.77	1.97
Egypt and Sudan	.04	.19	.14	.28	.26	.18	.67	1.07	1.14	.66	1.21	1.62	1.06
Union of South Africa	.04	.05	.04	.07	.03	.04	.01	.02	.05	.02	.05	.02	.03
Other British Africa[j]	.14	.20	.23	.34	.43	.27	.24	.37	.52	.70	.66	.65	.52
French Africa[j]	.02	.02	.02	.02	.01	.02	.04	.05	.06	.09	.09	.07	.07
Others[i]	.05	.04	.06	.09	.11	.07	.11	.58	.31	.16	.22	.41	.30
Oceania	.58	.65	.71	.75	.78	.69	.61	.73	.65	.70	.75	.71	.69
New Zealand	....	....	x	....	....	x	x	x	....	....	x	x	x
Hawaii	.49	.56	.60	.64	.66	.59	.55	.65	.55	.59	.65	.60	.60
Others[m]	.10	.09	.11	.12	.13	.11	.06	.08	.10	.11	.09	.11	.09
Total	21.83	27.85	35.03	33.81	31.31	29.97	27.26	34.95	46.04	40.32	30.57	32.81	35.33

* For sources and footnotes, see Appendix Table I.

TABLE IV.—CANADIAN NET EXPORTS OF WHEAT AND FLOUR (AS WHEAT) TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR*

(Million bushels)

Area	1909–10	1910–11	1911–12	1912–13	1913–14	Pre-war average	1921	1922	1923	1924	1925	1926	Post-war average
North and Central America	2.44	3.43	3.20	2.97	3.62	3.13	4.03	5.59	6.97	6.39	5.44	6.39	5.80
Newfoundland	1.41	1.12	1.38	1.25	1.29	1.29	1.61	1.55	1.86	1.65	1.40	1.44	1.58
Mexico	.08	.59	.05	....	....	.14	.01	.02	.14	.04	.01	.23	.07
Central America[a]	....	....	....	....	....	....	.05	.10	.13	.16	.15	.17	.13
Cuba	....	....	....	....	....	....	.23	.94	1.06	.91	.53	.64	.72
Haiti	....	....	....	....	....	....	.01	.09	.31	.29	.24	.14	.18
British West Indies	.93	1.73	1.74	1.72	2.31	1.69	2.07	2.73	3.28	3.15	2.91	3.52	2.94
Jamaica	....	....	....	....	....	....	.28	.65	.99	1.04	.78	1.26	.83
Trinidad and Tobago	....	....	....	....	....	....	1.05	1.22	1.32	1.11	1.13	1.26	1.18
Others[b]	....	....	....	....	....	....	.74	.86	.97	1.00	1.00	1.00	.93
Other West Indies	....	....	....	....	....	....	.04	.13	.16	.17	.17	.23	.15
French	....	....	....	....	....	....	.01	.05	.04	.05	.10	.13	.06
San Domingo	....	....	....	....	....	....	.02	.06	.11	.11	.06	.07	.07
Others[c]	....	....	....	....	....	....	.01	.02	.01	.01	.01	.03	.01
Miscellaneous[d]	.02[e]	....	.03[e]	....	.02[e]	.01[e]	.03	.02	.03	.02	.03	.03	.03
South America	.16	.23	.23	.30	.46	.28	.77	1.25	2.13	1.92	1.52	3.88	1.91
Brazil	....	....	....	....	....	....	.01	.02	.35	.15	.19	1.92	.44
Peru	....	....	....	....	....	....	....	x	.35	.44	.19	.40	.23
British Guiana	.16	.23	.23	.30	.36	.26	.56	.74	.80	.70	.63	.72	.69
Venezuela	....	....	....	....	.09	.02	.18	.45	.57	.60	.50	.74	.51
Others[f]	....	....	....	....	....	....	.02	.04	.05	.02	.02	.09	.04
Asia	.18	.09	.32	.60	1.45	.53	.50	5.08	8.94	18.65	14.17	18.95	11.05
China[g]	.11	.07	.28	.29	.81	.31	.10[h]	1.19	3.75	11.27	7.39	7.90	5.27
Japan	.06	.02	.04	.30	.64	.21	.40	3.88	5.16	7.35	6.73	10.90	5.74
Philippines	....	....	....	....	....	....	....	x	.02	.03	.02	.09	.03
Western Asia[i]	....	....	....	....	....	....	....	....	....	.01[j]	.02	.04	.01
Others[k]	....	....	....	....	....	....	....	....	....	....	....	.02	x
Africa	1.18	.91	.94	1.57	1.43	1.20	.80	.90	1.73	1.64	1.35	1.39	1.30
Egypt	.02	x	x	.03	.06	.02	.03	.50	.58	.58	.64	.56	.48
Union of South Africa	1.16	.90	.94	1.54	1.32	1.17	.07	.30	1.04	.92	.57	.58	.58
Other British Africa[l]							x[m]	.02[m]	.06	.07	.06	.12	.06
French Africa[n]	....	....	....	....	....	....	.67	.05	x	.02	x	.04	.13
Others[o]	....	....	....	....	.05[p]	.01	.02	.02	.05	.06	.08	.09	.05
Oceania[q]	x	.01	.01	x	x	.01	....	....	....	....	x	.01	x
Total	3.95	4.67	4.71	5.43	6.95	5.14	6.09	12.81	19.77	28.60	22.49	30.62	20.06

* Data for pre-war years from *Canadian Sessional Papers*, L, 378, 386; for post-war years from *Monthly Report of the Trade of Canada*. Pre-war data for July–June years. Flour converted to wheat at 4.5 bushels per barrel. Dots (....) indicate years when no exports were reported to designated destinations. Exports of less than 5,000 bushels are indicated by "x."

[a] British Honduras, Costa Rica, Guatemala, Honduras, Panama.
[b] Bermuda, Barbados, other British West Indies.
[c] Dutch West Indies.
[d] St. Pierre and Miquelon.
[e] St. Pierre only.
[f] Colombia, Dutch Guiana.
[g] Includes Hongkong.
[h] Hongkong only.
[i] Syria and Palestine.
[j] Syria only.
[k] Straits Settlements.
[l] British West Africa, British East Africa.
[m] British West Africa only.
[n] Precise destinations not ascertainable.
[o] Liberia, Portuguese Africa, Spanish Africa.
[p] Portuguese Africa only.
[q] Australasia in pre-war years; New Zealand in post-war years.

TABLE V.—CANADIAN NET EXPORTS OF WHEAT TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR*

(Million bushels)

Area	1909–10	1910–11	1911–12	1912–13	1913–14	Pre-war average	1921	1922	1923	1924	1925	1926	Post-war average
North and Central America	.08	.59	.05	x	.01	.15	....	x	.05	.15	x	.21	.07
Newfoundland	....	x	x	x	x	x	....	....	....	....	....	....	....
Mexico	.08	.59	.05	....	....	.14	....	x	.05	....	....	.21	.04
British West Indies	x	x	x	x	.01	x	....	....	....	.15	x	x	.03
Jamaica	....	....	....	....	....	....	....	....	....	.15	x	x	.03
Others[b]	....	....	....	....	....	....	....	....	....	....	....	....	....
South America	....	....	....	....	....	....	....	.02	.51	.44	.19	.97	.36
Brazil	....	....	....	....	....	....	....	.02	.16	....	....	.50	.11
Peru	....	....	....	....	....	....	....	x	.35	.44	.19	.40	.23
Others[f]	....	....	....	....	....	....	....	....	....	....	.01	.07	.01
Asia	....	x	.01	.24	.52	.15	.36	3.63	5.54	14.26	10.17	14.90	8.14
China[g]	....	....	....	....	....	....	....	.20	1.10	7.07	3.65	4.40	2.74
Japan	....	x	.01	.24	.52	.15	.36	3.43	4.44	7.19	6.51	10.50	5.41
Africa	.11	.05	.05	.11	.16	.09	.67	.05	.69	.55	.32	.39	.44
Union of South Africa	.11	.05	.05	.11	.16	.09	....	.01	.69	.53	.32	.35	.32
Other British Africa[i]							....	....	....	....	....	....	....
French Africa[n]	....	....	....	....	....	....	.67	.05	....	.02	....	.04	.13
Oceania[q]	....	x	x	....	x	x	....	....	....	....	....	....	....
Total	.18	.64	.11	.35	.69	.39	1.03	3.71	6.80	15.39	10.68	16.48	9.01

* For sources and footnotes, see Appendix Table IV.

TABLE VI.—CANADIAN NET EXPORTS OF FLOUR (AS WHEAT) TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR*

(Million bushels)

Area	1909–10	1910–11	1911–12	1912–13	1913–14	Pre-war average	1921	1922	1923	1924	1925	1926	Post-war average
North and Central America	2.36	2.85	3.15	2.96	3.61	2.98	4.03	5.59	6.92	6.24	5.44	6.18	5.73
Newfoundland	1.41	1.12	1.38	1.25	1.29	1.29	1.61	1.55	1.86	1.65	1.40	1.44	1.58
Mexico	....	....	....	....	....	....	.01	.01	.09	.04	.01	.02	.03
Central America[a]	....	....	....	....	....	....	.05	.10	.13	.16	.15	.17	.13
Cuba	....	....	....	....	....	....	.23	.94	1.06	.91	.53	.64	.72
Haiti	....	....	....	....	....	....	.01	.09	.31	.29	.24	.14	.18
British West Indies	.93	1.73	1.74	1.71	2.30	1.68	2.07	2.73	3.28	3.00	2.91	3.51	2.92
Jamaica	....	....	....	....	....	....	.28	.65	.99	.89	.78	1.25	.81
Trinidad and Tobago	....	....	....	....	....	....	1.05	1.22	1.32	1.11	1.13	1.26	1.18
Others[b]	....	....	....	....	....	....	.74	.86	.97	1.00	1.00	1.00	.93
Other West Indies	....	....	....	....	....	....	.04	.13	.16	.17	.17	.23	.15
French	....	....	....	....	....	....	.01	.05	.04	.05	.10	.13	.06
San Domingo	....	....	....	....	....	....	.02	.06	.11	.11	.06	.07	.07
Others[c]	....	....	....	....	....	....	.01	.02	.01	.01	.01	.03	.01
Miscellaneous[d]	.02[e]	....	.03[e]	....	.02[e]	.01	.03	.02	.03	.02	.03	.03	.03
South America	.16	.23	.23	.30	.46	.28	.77	1.23	1.62	1.48	1.33	2.91	1.56
Brazil	....	....	....	....	....	....	.01	x	.19	.15	.19	1.42	.33
Peru	....	....	....	....	....	....	....	....[f]	x	.01	x	x	x
British Guiana	.16	.23	.23	.30	.36	.26	.56	.74	.80	.70	.63	.72	.69
Venezuela	....	....	....	....	.09	.02	.18	.45	.57	.60	.50	.74	.51
Others[f]	....	....	....	....	....	....	.02	.04	.05	.02	.01	.03	.03
Asia	.18	.09	.31	.36	.93	.37	.14	1.44	3.39	4.40	4.00	4.05	2.90
China[g]	.11	.07	.28	.29	.81	.31	.10[h]	.99	2.65	4.20	3.74	3.50	2.53
Japan	.06	.02	.03	.07	.12	.06	.04	.45	.72	.16	.22	.40	.33
Philippines	....	....	....	....	....	....	....	x	.02	.03	.02	.09	.03
Western Asia[i]	....	....	....	....	....	....	....	....	....	.01[j]	.02	.04	.01
Others[k]	....	....	....	....	....	....	....	....	....	....	....	.02	x
Africa	1.07	.85	.90	1.46	1.26	1.11	.13	.85	1.04	1.10	1.03	1.00	.86
Egypt	.02	x	x	.03	.06	.02	.03	.50	.58	.58	.64	.56	.48
Union of South Africa	1.05	.85	.90	1.43	1.15	1.08	.07	.29	.35	.39	.26	.23	.26
Other British Africa[l]							x[m]	.02[m]	.06	.07	.06	.12	.06
French Africa[n]	....	....	....	....	....	....	....	.01	x	x	x	x	x
Others[o]	....	....	....	....	.05[n]	.01	.02	.02	.05	.06	.08	.09	.05
Oceania[q]	x	.01	.01	x	x	.01	....	....	....	....	x	.01	x
Total	3.77	4.03	4.60	5.08	6.26	4.75	5.07	9.10	12.98	13.21	11.81	14.14	11.05

* For sources and footnotes, see Appendix Table IV.

TABLE VII.—AUSTRALIAN EXPORTS OF WHEAT AND FLOUR (AS WHEAT) TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR*

(Million bushels)

Area	1909	1910	1911	1912	1913–14	Pre-war average	1921	1922	1923	1924	1925	1926	Post-war average
South America[a]	.63	1.27	1.59	1.20	.94	1.13	....	.78	.09	....	1.52	.46	.47
Asia	2.05	2.59	4.27	3.74	5.81	3.69	3.75	19.06	15.03	19.29	14.37	17.47	14.83
Ceylon	.11	.11	.15	.19	.26	.16	.26	.52	.39	.53	.54	.91	.53
China[b]	.09	.12	.35	.18	.22	.19	.21	.49	1.81	4.39	.61	1.33	1.48
Japan	.08	.27	.11	.06	1.24	.35	.61	7.26	8.08	9.62	8.00	9.79	7.23
Dutch East Indies	.73	1.02	1.75	1.75	2.29	1.51	1.55	2.11	2.33	2.49	2.54	2.83	2.31
Western Asia[c]	x	....	....	....	.01	x	....	....	.04	.02	....	.07	.02
Indo-China	.01	.03	.05	.02	.04	.03	.02	.05	.13	.05	.13	.10	.08
Philippines	.74	.45	.79	.77	.68	.69	.37	.51	.59	.51	.56	.41	.49
India	[d]	[d]	[d]	[d]	[d]	[d]	[d]	6.96	[d]	[d]	[d]	[d]	1.16
Others[e]	.30	.59	1.07	.76	1.06	.76	.72	1.15	1.66	1.68	1.99	2.03	1.54
Africa	5.41	5.64	5.00	4.04	9.18	5.85	15.35	9.76	13.64	16.42	15.07	12.40	13.77
Egypt and Sudan	.07	.02	.30	.75	1.89	.60	12.50	6.54	7.78	10.18	9.80	8.69	9.25
Union of South Africa	4.41	4.41	4.13	3.03	6.30	4.46	2.46	2.74	5.29	5.66	4.52	3.13	3.97
Other British Africa[f]	.15	.14	.09	.06	.09	.11	.25	.36	.36	.37	.21	.19	.29
French Africa[g]	x	....	....	....	....	x	....	....	....	.01	.06	.03	.02
Others[h]	.79	1.07	.47	.20	.90	.69	.14	.12	.20	.21	.47	.37	.25
Oceania	.68	.53	.58	.52	.60	.58	.56	.43	.48	3.93	3.22	3.17	1.97
New Zealand	.33	.16	.15	.08	.15	.17	.11	x	.01	3.39	2.68	2.59	1.46
Others[i]	.35	.37	.43	.44	.46	.41	.45	.43	.47	.54	.54	.58	.50
Total	8.78	10.03	11.44	9.50	16.53	11.26	19.65	30.03	29.23	39.64	34.18	33.49	31.04

* Data for pre-war years from *Trade and Customs and Excise Revenue of the Commonwealth of Australia;* for post-war years from *Quarterly Summary of Australian Statistics.* Flour converted to wheat on the assumption of a 70 per cent extraction. Dots (....) indicate years when no exports were reported to designated destinations. Exports of less than 5,000 bushels are indicated by "x."

[a] Peru only.
[b] Includes Hongkong.
[c] Palestine, Syria, Aden.
[d] Exports to India here given only for the year in which India was a net importer.
[e] Straits Settlements (Malaya), British Borneo, Siam.
[f] Mauritius.
[g] Madagascar in pre-war years; Reunion Island in post-war years.
[h] Portuguese East Africa, Canary Islands.
[i] Fiji, New Caledonia, New Hebrides, Society Islands, New Guinea, Tonga, Papua, other Pacific islands.

TABLE VIII.—AUSTRALIAN EXPORTS OF WHEAT TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR*

(Million bushels)

Area	1909	1910	1911	1912	1913–14	Pre-war average	1921	1922	1923	1924	1925	1926	Post-war average
South America[a]	.63	1.27	1.59	1.20	.94	1.13	....	.78	.09	....	1.34	.46	.44
Asia	.24	.23	.10	.05	1.22	.37	.44	14.23	7.95	13.51	7.97	10.76	9.14
Ceylon	x	x	x	x	x	x	x	.26	x	x	x	x	.04
China[b]	....	....	....	....	....	....	....	....	.64	3.90	....	.99	.92
Japan	.06	.23	.10	.04	1.22	.33	.44	7.07	7.31	9.60	7.97	9.78	7.03
Dutch East Indies	x	....	....	....	....	x	....	....	....	....	....	....	....
Philippines	.18	....	....	x	....	.04	....	....	....	....	....	....	....
India	[d]	[d]	[d]	[d]	[d]	[d]	[d]	6.90	[d]	[d]	[d]	[d]	1.15
Others[e]	x	....	....	....	....	x	....	....	....	....	....	....	....
Africa	3.24	3.00	2.69	2.21	4.73	3.17	8.66	3.08	3.41	5.62	5.29	2.66	4.79
Egypt and Sudan	....	....	.16	.43	.09	.14	7.31	1.79	.13	1.44	1.92	.44	2.17
Union of South Africa	3.23	3.00	2.46	1.78	4.48	2.99	1.35	1.29	3.28	4.12	3.37	2.22	2.60
Other British Africa[f]	x	....	....	....	....	x	....	....	....	....	....	....	....
Others[h]	x	x	.07	x	.16	.05	....	....	....	.06	....	....	.01
Oceania	.08	.01	.01	x	x	.02	.10	x	....	3.37	2.28	1.30	1.18
New Zealand	.07	.01	.01	x	x	.02	.10	x	....	3.37	2.28	1.30	1.18
Others[i]	x	x	x	x	x	x	....	....	....	....	....	....	....
Total	4.18	4.51	4.40	3.46	6.90	4.69	9.20	18.09	11.45	22.50	16.87	15.18	15.55

* For sources and footnotes, see Appendix Table VII.

TABLE IX.—AUSTRALIAN EXPORTS OF FLOUR (AS WHEAT) TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR*

(Million bushels)

Area	1909	1910	1911	1912	1913–14	Pre-war average	1921	1922	1923	1924	1925	1926	Post-war average
South America[a]	....	....	....	....	....	....	....	....	....	....	.18	....	.03
Asia	1.81	2.36	4.17	3.69	4.59	3.32	3.31	4.82	7.08	5.79	6.40	6.71	5.68
Ceylon	.11	.11	.15	.19	.26	.16	.26	.27	.39	.53	.54	.91	.48
China[b]	.09	.12	.35	.18	.22	.19	.21	.49	1.17	.49	.61	.34	.55
Japan	.02	.04	.01	.02	.03	.02	.17	.18	.78	.02	.03	.01	.20
Dutch East Indies	.73	1.02	1.75	1.75	2.29	1.51	1.55	2.11	2.33	2.49	2.54	2.83	2.31
Western Asia[c]	x	....	....	....	.01	x	....	....	.04	.02	....	.07	.02
Indo-China	.01	.03	.05	.02	.04	.03	.02	.05	.13	.05	.13	.10	.08
Philippines	.56	.45	.79	.77	.68	.65	.37	.51	.59	.51	.56	.41	.49
India	[d]	[d]	[d]	[d]	[d]	[d]	[d]	.06	[d]	[d]	[d]	[d]	.01
Others[e]	.30	.59	1.07	.76	1.06	.76	.72	1.15	1.66	1.68	1.99	2.03	1.54
Africa	2.18	2.63	2.31	1.83	4.45	2.68	6.69	6.68	10.22	10.80	9.78	9.74	8.98
Egypt and Sudan	.07	.02	.14	.32	1.79	.47	5.19	4.75	7.65	8.73	7.88	8.25	7.07
Union of South Africa	1.17	1.41	1.67	1.25	1.82	1.46	1.11	1.46	2.01	1.55	1.16	.91	1.36
Other British Africa[f]	.15	.14	.09	.06	.09	.11	.25	.36	.36	.37	.21	.19	.29
French Africa[g]	x	....	....	....	....	x	....	....	....	.01	.06	.03	.02
Others[h]	.79	1.07	.40	.20	.74	.64	.14	.12	.20	.15	.47	.37	.24
Oceania	.61	.52	.56	.52	.60	.56	.46	.43	.48	.55	.94	1.87	.79
New Zealand	.26	.15	.13	.08	.15	.15	.01	x	.01	.02	.40	1.29	.29
Others[i]	.35	.37	.43	.44	.45	.41	.45	.43	.47	.54	.54	.58	.50
Total	4.60	5.52	7.04	6.04	9.64	6.57	10.45	11.94	17.78	17.14	17.31	18.31	15.49

* For sources and footnotes, see Appendix Table VII.

TABLE X.—ARGENTINE EXPORTS OF WHEAT AND FLOUR (AS WHEAT) TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR*

(Million bushels)

Area	1909	1910	1911	1912	1913–14	Pre-war average	1921	1922	1923	1924	1925	1926	Post-war average
North and Central America	....	....	....	....	....	....	.10	x	x	x	.14	.07	.05
Cuba	....	....	....	....	....	....	x	x	x	x	x	.07	.01
Mexico	....	....	....	....	....	....	.10	....	....	....	.14	....	.04
South America	14.00	16.96	17.64	19.18	21.16	17.79	13.63	17.72	17.76	21.00	18.41	16.05	17.43
Brazil	13.96	16.88	17.32	18.56	20.36	17.42	13.04	16.63	16.04	19.87	17.16	15.76	16.42
Paraguay	.04	.08	.32	.62	.81	.37	.53	.57	.55	.94	1.08	.24	.65
Peru	....	....	....	....	....	....	....	.42	1.07	.09	.11	....	.28
Bolivia	....	x	....	x	x	x	.06	.09	.11	.09	.06	.05	.08
Asia	....	....	....	....	....	....	....	.07[a]	....	....	....	....	.01
Africa	....	.18	.15	.02	....	.07	.33	.23	.24	.28	.51	.32	.32
Egypt	....	....	....	....	....	....	.33	....	....	....	....	.32	.32
Union of South Africa	....	....	....	....	....	....	....	.23	.24	.28	.51		
Total	14.00	17.14	17.79	19.20	21.16	17.86	14.05	18.03	18.00	21.28	19.06	16.44	17.81

* Data for pre-war years from *Estadistica Agricola, 1917–18;* for post-war years from *Annuario del Comercio Exterior.* Flour converted to wheat on the assumption of a 70 per cent extraction. Dots (....) indicate years when no exports were reported to designated destinations. Exports of less than 5,000 bushels are indicated by "x."

[a] Reported as to Oriental kingdoms.

TABLE XI.—ARGENTINE EXPORTS OF WHEAT TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR *

(Million bushels)

Area	1909	1910	1911	1912	1913–14	Pre-war average	1921	1922	1923	1924	1925	1926	Post-war average
North and Central America	....	....	....	....	....	....	.10	....	....	x	.14	.02	.04
Cuba	....	....	....	....	....	....	....	....	....	x	....	.02	x
Mexico	....	....	....	....	....	....	.10	....	....	....	.14	....	.04
South America	8.63	11.70	12.37	13.12	15.59	12.28	11.62	14.61	15.19	15.88	14.13	12.50	13.99
Brazil	8.59	11.63	12.17	12.72	15.11	12.05	11.39	13.93	13.90	15.43	13.58	12.26	13.41
Paraguay	.04	.07	.19	.40	.48	.24	.23	.27	.22	.36	.44	.24	.29
Peru	....	....	....	....	....	....	....	.41	1.07	.09	.11	....	.28
Bolivia	....	x	....	x	x	x	x	x	....	....	x	x	x
Asia	....	....	....	....	....	....	....	.01[a]	....	....	....	....	x
Africa	....	.17	.15	.02	....	.07	....	.23	.24	.28	.51	.32	.26
Union of South Africa	....	....	....	....	....	....	....	.23	.24	.28	.51	....	....
Total	8.63	11.87	12.52	13.14	15.59	12.35	11.71	14.84	15.43	16.16	14.78	12.84	14.30

* For sources and footnotes, see Appendix Table X.

TABLE XII.—ARGENTINE EXPORTS OF FLOUR (AS WHEAT) TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR*

(Million bushels)

Area	1909	1910	1911	1912	1913–14	Pre-war average	1921	1922	1923	1924	1925	1926	Post-war average
North and Central America	....	....	....	....	....	....	x	x	x	x	....	.06	.01
Cuba	....	....	....	....	....	....	x	x	x	x	....	.06	.01
South America	5.37	5.26	5.27	6.06	5.57	5.51	2.01	3.11	2.57	5.12	4.28	3.54	3.44
Brazil	5.37	5.25	5.15	5.84	5.24	5.37	1.65	2.71	2.13	4.44	3.58	3.50	3.00
Paraguay	....	.01	.12	.22	.33	.14	.30	.30	.33	.58	.64	....	.36
Peru	....	....	....	....	....	....	....	.01	.01	x	....	....	x
Bolivia	....	....	....	....	....	....	.06	.09	.11	.09	.06	.04	.07
Asia	....	....	....	....	....	....	....	.06[a]	....	....	....	....	.01
Africa	....	.01	....	....	....	x	.33	....	....	....	....	....	.05
Egypt	....	....	....	....	....	....	.33	....	....	....	....	....	.05
Total	5.37	5.27	5.27	6.06	5.57	5.51	2.34	3.18	2.57	5.12	4.28	3.60	3.51

* For sources and footnotes, see Appendix Table X.

TABLE XIII.—BRITISH INDIAN EXPORTS OF WHEAT AND FLOUR (AS WHEAT) TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR*

(Million bushels)

Area	1909–10	1910–11	1911–12	1912–13	1913–14	Pre-war average	1921–22	1922–23	1923–24	1924–25	1925–26	1926–27	Post-war average
Asia	1.53	1.48	1.46	1.83	2.30	1.72	2.23	1.31	1.56	2.65	.53[a]	.98[a]	1.54
Ceylon	.32	.35	.42	.44	.39	.38	.50	.38	.36	.31	...	...	...
China[b]	(.07)[c]	(.09)[c]	(.10)[c]	(.08)[c]	(.14)[c]	(.10)[c]	(.07)[c]	(.07)[c]	.02	.02	...	...	...
Japan	...	...	...	x[c]	(.01)[c]	x[c]	...	...	...	...	...	...	...
Western Asia[d]	1.17	1.10	1.00	1.27	1.87	1.28	1.63	.87	1.04	2.18	...	...	...
Others[e]	.11	.12	.14	.20	.19	.15	.15	.12	.14	.14	...	...	...
Africa	.49	.63	1.52	1.77	2.05	1.29	1.43	1.22	1.30	4.77	.95[a]	1.70[a]	1.90
Egypt and Sudan	.07	.17	.86	1.09	1.31	.70	.91	.62	.71	3.80	...	...	...
Union of South Africa	...	...	...	x	x	x	...	.13	.09	.36	...	...	...
Other British Africa[f]	.31	.30	.46	.40	.39	.37	.49	.46	.48	.56	...	...	...
French Africa[g]	...	...	...	...	...	...	.01	x	...	...	...	...	...
Italian Possessions	...	...	...	...	x	x	x	x	.01	.02	...	...	...
Others[h]	.12	.15	.20	.27	.35	.22	.01	.01	.02	.02	...	...	...
Total	2.03	2.10	2.98	3.60	4.35	3.01	3.66	2.53	2.87	7.41	1.48[a]	2.68[a]	3.44

*Data for pre-war years from *Accounts and Papers of the United Kingdom;* for post-war years from *Annual Statements of the Sea-Borne Trade of British India.* Data are for April–March years. Flour converted to wheat on the assumption of a 70 per cent extraction. Dots (....) indicate years when no exports were reported to designated destinations. Exports of less than 5,000 bushels are indicated by "x."

[a] Estimated.
[b] Including Hongkong.
[c] Net import.
[d] Aden, Arabia, Persia, Turkey, Mesopotamia, Bahrein Islands, Syria, Smyrna, Palestine.
[e] Straits Settlements, Federated Malay States.
[f] Mauritius, Zanzibar, Pemba, Kenya, Tanganyika, Seychelles.
[g] Somaliland.
[h] Portuguese East Africa, German East Africa, East African Protectorate.

TABLE XIV.—BRITISH INDIAN EXPORTS OF WHEAT TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR*

(Million bushels)

Area	1909–10	1910–11	1911–12	1912–13	1913–14	Pre-war average	1921–22	1922–23	1923–24	1924–25	1925–26	1926–27	Post-war average
Asia	.33	.19	.06	.22	.53	.26	.31	(.17)[c]	(.19)[c]	.80	...	...	...
Ceylon	...	...	...	...	...	...	x	x	x	x	...	...	...
China[b]	.03	.03	.04	.04	.04	.04	.02	.02	.02	.02	...	...	...
Western Asia[d]	.30	.16	.03	.18	.48	.23	.28	(.20)[c]	(.22)[c]	.77	...	...	...
Others[e]	...	...	...	...	...	...	.01	.01	.01	.01	...	...	...
Africa	x	.01	.54	.11	.06	.14	.01	.14	.12	2.63	...	...	...
Egypt and Sudan	x	.01	.54	.11	.06	.14	...	...	.01	2.23	...	...	...
Union of South Africa	...	...	...	x	x	x	...	.13	.09	.36	...	...	...
Other British Africa[f]	...	...	...	...	...	...	.01	.01	.02	.02	...	...	...
Italian Possessions	...	...	...	...	x	x	x[c]	x[c]	...	.01	...	...	...
Others[h]	...	...	...	...	...	...	...	x	x	x	...	...	...
Total	.33	.19	.61	.33	.59	.41	.32	(.03)[c]	(.07)[c]	3.43	...	...	...

* For sources and footnotes, see Appendix Table XIII.

TABLE XV.—BRITISH INDIAN EXPORTS OF FLOUR (AS WHEAT) TO EX-EUROPE BY DESTINATIONS, PRE-WAR AND POST-WAR

(Million bushels)

Area	1909–10	1910–11	1911–12	1912–13	1913–14	Pre-war average	1921–22	1922–23	1923–24	1924–25	1925–26	1926–27	Post-wa average
Asia	1.20	1.29	1.39	1.61	1.77	1.45	1.92	1.47	1.75	1.85	...	...	...
Ceylon	.32	.35	.42	.44	.39	.38	.50	.38	.36	.30	...	...	...
China[b]	(.10)[c]	(.12)[c]	(.14)[c]	(.12)[c]	(.18)[c]	(.13)[c]	(.08)[c]	(.09)[c]	...	...	...	...	...
Japan	...	...	...	x[c]	(.01)[c]	x[c]	...	...	...	...	...	...	...
Western Asia[d]	.87	.94	.98	1.10	1.39	1.05	1.35	1.07	1.26	1.41	...	...	...
Others[e]	.11	.12	.14	.20	.19	.15	.15	.11	.13	.13	...	...	...
Africa	.49	.62	.98	1.66	1.99	1.15	1.42	1.09	1.18	2.14	...	...	...
Egypt and Sudan	.07	.16	.32	.98	1.25	.55	.91	.62	.69	1.57	...	...	...
Union of South Africa	...	...	...	...	...	...	...	...	...	...	...	...	...
Other British Africa[f]	.31	.30	.46	.40	.39	.37	.48	.45	.46	.54	...	...	...
French Africa[g]	...	...	...	...	...	...	.01	x	...	...	...	...	...
Italian Possessions	...	...	...	...	x	x	.01	x	.01	.01	...	...	...
Others[h]	.12	.15	.20	.27	.35	.22	.01	.01	.02	.02	...	...	...
Total	1.70	1.91	2.37	3.27	3.76	2.60	3.34	2.56	2.94	3.98	...	...	...

* For sources and footnotes, see Appendix Table XIII.

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OF THE

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VOL. IV, NO. 10 SEPTEMBER 1928

SURVEY OF THE WHEAT SITUATION

APRIL TO JULY, 1928

A SHARP advance and still more extensive recession of wheat prices, more marked in Chicago than in foreign markets, featured the period under review. Poor prospects for winter wheat in the Northern Hemisphere, especially the United States, were changed into good prospects as the season advanced. Spring-wheat crops made consistently good progress, especially in Canada. These developments and the weight of exceedingly high Canadian visible supplies brought wheat prices at the end of July to about the lowest levels recorded since the trough of post-war prices in 1923–24.

All the important wheat producers in the Northern Hemisphere except India now appear to have harvested crops of average size or better; and in Canada, the Danube countries, and northern Africa the crops are of record size for post-war years. Exclusive of Russia, China, and Asia Minor, the Northern Hemisphere crop is apparently over 3,200 million bushels, the largest since the war. Exportable surpluses promise to be the largest in post-war years even if Argentina and Australia should have only average yields.

The international statistical position is clearly easier than in 1927–28, and apparently nearly as easy as in 1923–24. Taken at their present face value, the data suggest that a world wheat price level the lowest since 1923–24 seems likely to prevail in the coming months, even if weather conditions should prove somewhat unfavorable for later harvests in the Northern Hemisphere and for further development in Argentina and Australia. Under these circumstances, international trade in 1928–29 ought to be heavy, perhaps of record size.

STANFORD UNIVERSITY, CALIFORNIA

September 1928

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FOOD RESEARCH INSTITUTE

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SURVEY OF THE WHEAT SITUATION

APRIL TO JULY, 1928

The crop year 1927–28, in most respects less eventful than the preceding four years in the first two-thirds of its course, closed spectacularly. During March and April average cash wheat prices advanced in the United States from mid-winter levels the lowest in the past four years to a peak in early May higher than had been recorded on a similar date in five years. A steady and extensive decline ensued; and by the end of July prices in the leading markets of the world had reached about the lowest levels recorded since the trough of prices in the year 1923–24.

The advance was due chiefly to the bad outlook for winter wheat in the United States, especially east of the Mississippi, and in several countries of Europe; it was achieved in the face of exceptionally high visible supplies in the United States and Canada. The abrupt decline was caused in part by a striking reversal in the outlook for winter-wheat crops, especially in the United States but also in Europe; in part by practically undisturbed good progress of the Canadian spring-wheat crop; and in part to pressure of visible supplies turned burdensome as the crop outlook improved. These changes in prices were more extreme in the United States than elsewhere, and greater in Canada than in the United Kingdom or Argentina. The crop year closed with wheat stocks of record size in Canada despite liberal offers and very heavy exportation from that country in June and July.

Total net exports of approximately 821 million bushels in 1927–28 now appear to have fallen slightly below our advance estimates, rather because Russia now seems to have imported about as much as she exported than because the export movement was curtailed by unforeseen developments. Principally because the bad crop outlook followed by keen Canadian competition restricted American exports, partly because the crop of 1927 may have been overestimated, net exports from the United States fell below our December forecast. Canadian and Argentine net exports proved higher; the crops of both countries appear to have been underestimated, though other factors contributed to the divergence of reported movements from those anticipated.

The broad outlines of the international statistical position likely to prevail in 1928–29 are fairly clear, in spite of incomplete knowledge of wheat production in the Northern Hemisphere and the fact that south of the equator the harvests are still distant. This hemisphere, excluding Russia, China, and Asia Minor, now appears likely to harvest the largest crop of post-war years. The exporting countries of the Northern Hemisphere, India and Russia excepted, almost certainly have larger crops this year than last; European importing countries have crops of wheat little if any smaller, though the rye crop is short. With India a net importer in 1928–29, both European and ex-European importing countries may be expected to "require" more wheat than in 1927–28. But exportable surpluses seem clearly to be larger by comparison with those of 1927–28 than are the "necessary" requirements of importing countries. On the assumption that the Southern Hemisphere crops will prove at least of average size, we anticipate a distinctly easy international statistical position in 1928–29—if the Argentine and Australian crops prove distinctly good, perhaps almost as easy a position as prevailed in 1923–24. Hence the reasonable prospect is for a year characterized by a corresponding level of wheat prices, relatively small fluctuations, and a very heavy, perhaps a record, volume of international trade.

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I. NEW CROP DEVELOPMENTS

The notable reversal in the wheat-crop outlook was the outstanding feature of the four months under review. Last April winter-wheat crops were commonly expected to be poor, or at least below average, in the United States, western Europe, and in Russia as well. With spring-wheat seeding scarcely begun, there was no basis for expecting the spring-wheat crops to be above average. Expectations of a short world crop sent prices up. Early in May, however, conditions began to change, and as the weeks passed the crop prospects appeared better and better. In most countries, from May through August, the weather proved distinctly favorable for growing and harvesting. Winter wheat recovered remarkably, especially in the United States; and spring wheat came forward, especially in Canada, under consistently favorable weather conditions. By mid-August almost all of the winter-wheat crops of the Northern Hemisphere outside of Russia no longer appeared poor but of average size or better, and the spring-wheat crop promised to be distinctly large. Moreover, accumulating evidence from Argentina and Australia indicated large acreages sown under favorable conditions, and unusually satisfactory growing conditions, thus presaging good outturns in the Southern Hemisphere. The changes in crop prospects exerted a prompt and profound influence on prices and trade.

India and Northern Africa

India's crop alone now appears materially below earlier expectations. The acreage sown was increased; the winter was fairly favorable; and average conditions or better prevailed as late as March. The April official forecast pointed to an average crop of 331 million bushels. In its later stages, however, the crop suffered from rust damage and unfavorable harvesting weather, and the final estimate is only 290 million. This is a small crop for India—apparently the smallest since 1921, and less than India usually consumes. Since it follows three years of moderate crops, India seems likely to export little wheat in 1928–29 and to import substantial quantities from Australia in the winter months.

In the French dependencies of northern Africa, an increase in the acreage sown and exceptionally heavy winter rains apparently resulted in a bumper crop. Although no official estimate for Morocco has yet appeared, the combined crop of Morocco, Algeria, and Tunis seems to be about 75 million bushels, the largest in post-war years, and some 14 million larger than the crop of 1927. Production of bread wheat as contrasted with durum is said to be increasing in this region, and the present crop is thought to contain more soft wheat than ever before. France will presumably obtain larger duty-free imports than usual from this source. The Egyptian crop is unofficially reported to fall below last year's exceptionally large outturn, but is apparently of average size.

The United States

The winter-wheat crop of the United States, as a result of extraordinarily favorable weather during the later part of the growing season, turned out much larger than seemed probable in April and early May. The area sown, tentatively estimated in December 1927 as 47.9 million acres, was one of the three largest in history. The winter, however, was unfavorable; and official figures as of May 1 showed abandonment of 25.1 per cent, the highest figure except that of 1917 since estimates of abandonment were instituted in 1900. Private estimators had anticipated some such figure a month earlier. The soft red winter-wheat areas suffered the heaviest winter-killing. In Ohio, Indiana, Illinois, and Kentucky the abandonment ranged between 65 and 67 per cent, by far the highest ever recorded in these states and indeed close to the highest ever recorded in any state.[1] This reduction brought the acreage remaining for harvest to a relatively low figure,

[1] Higher abandonment in individual states since 1901 has been reported only in Montana, New Mexico, Washington, and Oregon in 1925, when the figures ranged from 70 to 72 per cent.

35.9 million acres,[1] the smallest in post-war years except 1924 and 1925, when the areas sown were only 38.9 and 39.8 million acres, respectively.

Condition as of April 1, officially placed at 68.8 per cent, was the lowest since 1879, except for 1917 and 1925. The trade regarded the official report issued on April 12 as distinctly bullish. The month of April brought no general improvement in prospects, but rather the reverse. The Pacific northwest enjoyed favorable weather, but elsewhere there was deterioration. In most regions cold weather retarded growth, and drought caused complaints in Nebraska and Oklahoma especially.[2]

After April, however, the progress was generally satisfactory. Warm weather prevailed during May; there were generous rains in the dry areas of the hard winter-wheat belt; and crops showed good progress everywhere except in the Pacific northwest, which suffered from heat and drought. June weather also was favorable on the whole, though rains were rather heavy and frequent for harvesting operations during the latter half of the month, and drought continued in the Pacific region. July brought no reversals aside from some heavy rains. There was little damage from disease or pests, and weather conditions apparently favored the filling of heads to an exceptional degree. The harvest was begun and completed at about the usual dates, despite the late spring. Receipts at United States primary markets attained large volume in the third week of July, a little earlier than in 1923–25, a little later than in 1926, and at about the same time as in 1927.[3]

The foregoing summary of weather conditions inadequately portrays the remarkable reversal of winter-wheat crop prospects in the course of April–August. At the beginning of April, observers anticipated (tentatively in view of the early date) a crop only a little below average. No official estimate was made, but unofficial forecasts of production ranged from 510 to 556 million bushels,[4] and averaged 536 million. That the figures were put as high as this was due not to even moderately favorable reports of condition, but to the large acreage sown and doubts respecting the extent of abandonment. Developments in April led to sharp reductions in expectations.

Unofficial forecasts appearing around May 1 ranged from 455 to 487 million bushels, and averaged 471 million. This was 65 million below the April 1 average, but since many traders had anticipated still greater reductions these forecasts were commonly construed as bearish. The official forecast, appearing May 9 and corrected upward on May 11, was 486 million bushels.[5] Since it reflected still less deterioration than traders were counting upon, it too was given a bearish interpretation.

In short, late in April, before weather conditions had changed for the better, the trade in general anticipated a smaller winter-wheat crop than the expert forecasters predicted as of May 1. The favorable weather of May–July led to successive increases in both official and private estimates, as shown by Table 1 (p. 360).

The official estimate as of July 1, showing an increase of 32 million bushels over the June 1 estimate while private estimates had shown an average increase of only 7 million bushels, took traders by surprise. Private estimates as of August 1 averaged 92 million bushels above those of May 1; the official estimate as of August 1 was 93 million bushels above the May forecast, reflecting a change in prospects quite as

[1] As of July 1, however, the area remaining for harvest was officially given as 36.1 million acres.

[2] The official estimate of condition as of May 1 showed a higher figure than that of April 1, but May condition figures apply to areas remaining for harvest, while April condition figures apply to areas sown. Hence the higher May figure (73.8 per cent as compared with the April figure of 68.8 per cent) cannot be regarded as indicating improvement in the crop during April. The official production forecast, not the condition figure, was regarded as bearish by the trade.

[3] See Appendix Table II.

[4] Private estimates of United States winter-wheat production, in million bushels as of about the first of the month indicated, were as follows:

Estimator	Apr. 1	May 1	June 1	July 1	Aug. 1
Bryant	556	487	507	509	540
Cromwell	529	485	505	516	561
Donovan	540	460	510	525	565
Murray	543	466	512	522	552
Snow	510	455	531	528	595
Average	536	471	513	520	563

[5] In the report issued on May 9, the production forecast was erroneously given as 479 million bushels. This was corrected on May 11, and the insignificant addition of 7.4 million bushels was said to have contributed to a sharp break in Chicago futures.

striking as that shown by private estimates. No such pronounced reversal in prospects occurred in any other year of the period 1922–28, as the table shows. Even in 1926, a year when May–July weather conditions altered the expectation from an average crop in May to a bumper crop in August, the increase in both private and official estimates was smaller. Comparable occurrences, in both instances involving deterioration rather than improvement, are to be found only in 1919 and 1921.[1] The gradual addition of over 90 million bushels—nearly 19 per cent, using official figures—to the prospective winter-wheat crop was a bearish factor of much influence both here and abroad.

TABLE 1.—COURSE OF OFFICIAL FORECASTS OF UNITED STATES WINTER-WHEAT PRODUCTION, MAY–AUGUST, 1922–28, AND OF UNOFFICIAL FORECASTS FOR 1926–28*

Year	Forecast	May	June	July	August	Net Change
1922...	Official	585	607	569	542	−43
1923...	Official	578	581	586	568	−10
1924...	Official	553	509	543	589	+36
1925...	Official	445	407	404	416	−29
1926...	Official	549	543	568	626	+77
	Private	552[a]	566[a]	562[a]	618[a]	+66
1927...	Official	594	537	579	553	−41
	Private	597[a]	560[a]	559[a]	551[a]	−46
1928...	Official	486	512	544	579	+93
	Private	471[b]	513[b]	520[b]	563[b]	+92

* Official data from *Crops and Markets* and press releases; unofficial data compiled from *Daily Market Record*. Unofficial estimates appear about the first of the month, official estimates about the tenth.

[a] Averages of estimates by Messrs. Bryant, Cromwell, Murray, and Snow.

[b] Averages of estimates by Messrs. Bryant, Cromwell, Donovan, Murray, and Snow.

[1] In 1919 the May forecast was 185 million bushels above the August estimate; and in 1921 the May forecast was 85 million above the August estimate. Subsequently, however, both of these August estimates were revised upward so substantially that they fell below the May forecasts by only 140 and 29 million bushels, respectively.

[2] Official and private forecasts were as follows, in million bushels:

Estimator	June 1	July 1	August 1
Bryant	248	240	272
Cromwell	245	254	282
Donovan	255	250	290
Murray	264	245	301
Snow	260	250	302
Average	254	248	290
Official	...	256	313

Prospects for the American spring-wheat crop also improved during the period, especially after July 1. Cold weather in April was not favorable for seeding and germination. But May weather was satisfactory except for drought in an area centering in northeastern South Dakota. Private forecasts as of June 1 averaged 254 million bushels, a crop of fair size but much below the 319 million bushel crop of 1927.

During early June there was deterioration from drought, especially in South Dakota, but beneficial rains came in the latter part of the month, except in the Pacific northwest. Private estimates as of July 1 mostly pointed to a slight reduction, and averaged 248 million bushels. The first official estimate was 256 million. Weather in July and August appears to have been exceptionally favorable for filling heads. There was ample rainfall everywhere, though the Pacific northwest benefited least. Private estimates as of August 1 averaged 42 million above the July 1 average. The official forecast, 313 million bushels, was 23 million above the average of the unofficial forecasts, and more than confirmed a substantial improvement in the outlook during July.[2]

Crop estimates now standing are of course subject to further revision, especially with regard to spring wheat, and definitive comparisons cannot yet be made. According to the latest official estimates, however, the winter-wheat crop of 1928 does not rank with the small crops of 1925 and 1917, as seemed probable in early May, but is well above average in size. At 579 million bushels, it is distinctly smaller than the fine crop of 1926, but larger than that of 1927. The average yield per acre indicated, 16.0 bushels, is rather high, though not an extraordinary figure. The spring-wheat crop appears to be one of the five largest crops since 1910, and about as large as the excellent crop of last year. The area sown, reported as over 21.6 million acres, is larger than any harvested area since 1910 except those of 1918 and 1919, and nearly a million acres larger than the acreage of 1927. The area sown to durum wheat, reported as 6.1 million acres, appears to be the largest in history.

The total United States crop, according to the official August estimate, reaches 891 million bushels. It is clearly one of the largest crops in history, being distinctly exceeded by only those of 1915, 1918, and 1919. It equals the excellent crop of 1914, and exceeds the crop of 1927 by 19 million bushels. Four months ago many, probably most, observers anticipated a distinctly small outturn, perhaps not much more than 700 million bushels. The difficulty of predicting final outturns from spring condition and acreage estimates has rarely been illustrated more forcibly.

The distribution of the United States wheat crop between the various classes is distinctly peculiar. The outturn of soft red winter wheat is far below the average of the past five years, much smaller even than the distinctly short crops of 1927 and 1925. Production was relatively most curtailed in Ohio, Indiana, and Illinois. The hard red winter-wheat crop, on the other hand, is distinctly large. Kansas, Nebraska, and Oklahoma have crops of exceptional size, and that of Kansas now appears the largest in history. The Pacific white wheat crop is apparently not so large as that of 1927, but is still well above average. The same is true of hard red spring. The durum crop appears to be the largest since 1922. Hence there is an abundance of all types of wheat except soft red winter, and of this the shortage is more pronounced than in any other post-war year.

As to quality, it is too early to say much with certainty. Rain at harvest appears to have resulted in large quantities of hard red winter wheat of rather low weight per measured bushel; and protein content seems to be low. Early marketings of spring wheat have been favorably commented upon. It now seems improbable that the high premiums for protein content on hard red spring wheat prevailing in 1927–28 will be maintained in 1928–29, though the reverse may be true of hard winter, which now carries substantial premiums.

Canada

Canadian crop developments, unlike the American, did not represent a progression from poor prospects to excellent, but rather an unusual maintenance of excellent prospects which was practically undisturbed at least to the date of writing (August 25). Spring-wheat sowing did not begin early. According to official data, only 10 per cent of intended sowing had been accomplished by April 30. This was the lowest figure in fourteen years except that of 1927, though only a little lower than those for 1917, 1920, 1923, and 1924. But progress was apparently very rapid in early May; and the *Manitoba Free Press,* usually a reliable authority, stated on May 19 that the largest area since 1921 had been seeded by May 10 in the Prairie Provinces, while 90 per cent of the sowing had been accomplished by May 18. The seedbed was described as one of the best in fourteen years, and the percentages of summer fallow and new breaking were said to be exceptionally high.

The crop was favored by opportune rains in early June, just at the time when moisture was most desired. Ample moisture became available throughout June and early July. Warm dry weather prevailed when it was desired in late July and early August. There were no serious complaints of rust, frost, or insect damage throughout the growing season, though hail caused some damage in restricted areas. The progress of the crop differed sharply from last year, when seeding was late and frost and rust damage threatened almost continuously in July and August to reduce the outturn, which nevertheless proved exceptionally large. Last year during May–August a large crop seemed possible only if weather conditions proved exceptionally favorable; this year a large crop has seemed increasingly probable unless weather conditions turned exceptionally unfavorable.

Opinions differ with respect to acreage. All observers agree that the acreage sown to spring wheat in the three Prairie Provinces exceeds that harvested in 1927; but there is a considerable range of opinion respecting the extent of the increase. Unofficial estimates published after June 1 ranged from 21,700,000 acres (Bryant) to 23,666,000 (Cromwell). The first official preliminary estimate, issued July 10, was 22,440,000 acres. The second official estimate, issued August 11, was 23,099,000 acres, still somewhat below the highest

unofficial figures.[1] For all Canada, winter and spring wheat, later official figures suggest an area of about 24.1 million acres, the largest in history.

Unofficial forecasts of the spring-wheat crop of the Prairie Provinces, by leading American estimators, were as follows, in million bushels:

Estimator	June 1	July 1	August 1
Bryant	399	404	412
Cromwell	389	427	479
Murray	405	456	513

The later figures illustrate the prevailing wide differences of opinion respecting the probable outturn; but they are in harmony in suggesting a distinctly large crop and in showing increases from month to month. Contrary to the usual practice, no official forecast of production was issued in July or August, and an official view of the outturn will presumably be delayed until mid-September. Interpretations of the condition figure for July 31 (107 per cent of the 10-year average yield per acre of spring wheat) differ considerably, and need not be attempted here.

The total Canadian crop may conceivably range anywhere from 450 to over 600 million bushels. In view of the good progress of the crop in early August (despite light frosts on several days between the 14th and 25th), a crop of less than 500 million bushels seems improbable, and a crop of 600 million is a possibility. Rust damage appears to have been negligible. Frost can still cut down yields, but not greatly because the crop is too far advanced, and the damage would affect quality more than quantity. Harvest rains, such as occurred in the past two seasons, would lower quality and might somewhat reduce merchandizable volume. On the whole a record Canadian crop seems to be expected at the date of writing (August 25); and average quality—better than in 1926 or 1927—must be anticipated if later weather conditions do not prove extremely unfavorable, as they seem to have been in the two preceding years. So far as the world market is concerned, the crop developments in Canada have been even more weighty than those in the United States.

[1] This estimate apparently applies to all wheat in the Prairie Provinces, not to spring wheat alone. The area there sown to fall wheat, however, is small.

Europe, Excluding Russia

As in the United States, though to a much less marked degree, unfavorable spring prospects for European winter-wheat crops turned into favorable prospects in most countries as the growing season advanced. An unfavorable winter led to considerable winterkilling, especially in Poland and France but in other countries of central and eastern Europe as well. April weather was variable, but mostly cold. By the beginning of May winter-wheat crops were backward and rather poorer than usual. In May also cool weather with night frosts prevailed in many countries, and crop conditions seem not to have improved greatly except in Italy and the Danube countries. Three weeks of warmth at the end of May and early June greatly improved prospects in France, Germany, and England. The last two weeks in June were rather too cold and rainy in western Europe, but favorable elsewhere. July weather in general, however, appears to have been exceptionally suitable for the ripening and harvesting of wheat, thus largely compensating for the retarded development of April–May.

So far as can be judged from unofficial advices and published official reports, southeastern European countries are almost assured of wheat crops of exceptional size and quality. The Italian crop, estimated at 235 million bushels in July, appears to be the second largest in history, nearly 40 million above the crop of 1927. On the basis of present indications, the Hungarian, Bulgarian, and Roumanian crops of 89.5 million, 51.1 million, and 113.9 million bushels, respectively, are of record size. The Jugo-Slavian crop, officially estimated as 105.4 million bushels, is similarly large. The Greek crop of 16.5 million is by far the largest of post-war years. These countries enjoyed more favorable spring weather than more westerly and northerly countries, and for the most part harvested under ideal conditions. The combined crop of Italy, Hungary, Jugo-

Slavia, Roumania, Bulgaria, and Greece, about 612 million bushels, now appears to be the largest of post-war years. It exceeds the crop of 1927 by about 125 million bushels, and the best previous post-war crop, that of 1925, by about 63 million. In all of these countries quality is reported to be distinctly good.

The situation is less clear in western and northern Europe, since harvesting has not progressed so far and official estimates for many countries have not been issued. The important wheat-producing countries of this region are Spain, France, Germany, Great Britain, Czecho-Slovakia, and Poland. Official preliminary estimates of production are available only for Spain, where the crop of 141 million bushels is slightly below last year's average crop. Observers agree fairly well in anticipating for France a crop of about 240–260 million bushels—somewhat below average in quantity, but fair in quality, especially in comparison with the crops of 1925 and 1927. On account of a reduced acreage and many fields with thin stands, the British crop is expected to fall below last year's and below average. In Germany an outturn equal to the large crop of 1927 is not anticipated, though the crop is commonly expected to exceed the 5-year average of 106 million bushels. In Poland, where winterkilling reduced the acreage by over 9 per cent (according to official data), the crop is expected to prove rather small. In Czecho-Slovakia prospects are apparently better, though most of the acreage is spring-sown wheat which is more susceptible to reverses than is winter-sown. Among the smaller producers, official estimates point to the smallest crop of post-war years in Portugal, only 6.6 million bushels, and to a good crop of 6 million in Holland. A large crop is anticipated in Austria.

Comparisons of European wheat production in 1928 with that of 1927 remain uncertain at least for the northwestern countries. But April–July crop developments, particularly those of June and July, seem clearly to have resulted in larger crops in southern and southeastern Europe than were anticipated in the spring; and they appear to have improved the situation elsewhere practically without exception. Northern and western Europe perhaps has a smaller crop than that of 1927, though still of average size. The first half of August was mostly favorable for harvesting, and improved the outlook further. It seems reasonable to suppose that a considerable proportion of the crop of western Europe has been gathered under much more favorable circumstances than prevailed last year, and hence that, even in the event of a rainy September, there will be a larger proportion of good milling wheat.

Russia

Crop developments in Russia cannot be described with any precision. Official statements, almost without exception, have tended toward optimism; unofficial comments of uncertain origin have tended toward pessimism. It is only natural that crop prospects over so large a territory should be difficult to summarize with precision, and that misinterpretation of either official statements or private messages should commonly occur.

According to official statements, the area sown to winter wheat was 27,794,000 acres, some 737,000 more than in the preceding year. Winterkilling was said to have been exceptionally heavy; the extent has not been specified, but may have reached 4 million acres.[1] Whether or not the sowings of spring wheat made up for this deficiency is not yet a matter of record, but in June it was stated that sowings of bread grains were smaller than in 1927. April was characterized as a cold month in which growth was retarded. Early in June, however, the condition of winter wheat was described as favorable, and that of spring wheat as 15 per cent above average. Early in July, June was described as a month of good progress, and prospects were said to indicate a larger harvest than that of 1927. Later in July winter-wheat condition as of July 1 in all Russia was placed at 96 per cent (100 per cent equals an average yield), spring-wheat

[1] In July it was stated that 13 million acres of *all* fall-sown grain had been winterkilled; some 29 per cent of the total sown was sown to wheat; and if wheat and other grains suffered in the same proportion the area of wheat winterkilled would be 3.77 million acres.

condition at 143 per cent. Still later it was stated that wheat production in European Russia would reach 648 million bushels as compared with 584 million in 1927. The *London Grain, Seed and Oil Reporter* of July 27 characterized a higher outturn this year than last as "most unlikely," because "preparations are in hand for supplying the peasants with seed for sowing in the coming Autumn," and spoke of the official estimates as "questionable."

From such information as can be gathered from diverse sources, it seems probable that the Russian crop may prove fairly small in the heavy surplus-producing regions of the Ukraine and North Caucasia, but that farther north and east the crop may be of exceptional size. Apparently it is the winter-wheat crop, largely concentrated in the southern areas, which shows least promise. No convincing reason appears for questioning the official view that the total wheat crop may exceed last year's. The official plan to supply peasants with seed appears to apply to winter wheat, not spring, and it may apply to particular areas; and Russian purchasing of wheat in July may have been caused by other factors than an outlook for a deficient wheat harvest. Among these, the difficulties in collecting grain in the south for transportation to urban centers in the north have received mention, and also the possibility that wheat was imported at low prices in order that more higher-priced Russian wheat might be exported later. The official forecast may prove correct, and is not in itself unbelievable; but the Russian crop is not yet harvested. Meanwhile it is well to take with reserve the view expressed in some quarters that Russia must import heavily in 1928–29 or in any event will have no surplus for export.

The Southern Hemisphere

Last year, during April–July, drought in Australia and Argentina was a bullish factor on world markets, though not one of great effectiveness. This year Southern Hemisphere prospects have tended to exert a bearish influence, though again not of great significance. Both Australia and Argentina received liberal rains during the period of sowing and germination. Most reports indicate considerable increases in acreage in both countries. The official Argentine estimate of acreage sown, issued August 17, showed an area in 1928 of 20.25 million acres in comparison with 19.7 million sown last year. Conditions for growth have thus far been favorable, in both countries. Accordingly the developments well into August have consistently pointed to the possibility that large crops in the exporting countries of the Southern Hemisphere will be added to the large crops in North America, northern Africa, and the Danube countries; but this prospect may be altered at any time.

II. VISIBLE SUPPLIES AND OUTWARD CARRYOVERS

Throughout the latter half of the crop year 1927–28, commercial visible supplies in the Northern Hemisphere have run extraordinarily high. In the face of these large and readily available stocks of wheat, European importers were obviously in a position more comfortable than usual. The existence of such visible supplies apparently served to restrain the upward movement of wheat prices in March–April, when crop prospects seemed increasingly unfavorable; but it seems to have been more influential in Liverpool than in Winnipeg, and in Winnipeg than in Chicago. It tended to accentuate the decline of May–August, and to do so in all markets. Practically without exception traders attributed the upward course of prices in March–April to the changing outlook for new crops; but much weight was given to visible supplies as a cause of decline in May–July. "It is a little difficult to tell," says the *London Grain, Seed and Oil Reporter* of July 27, "whether the pressure to sell old crop Manitoba or the good prospects of the new crop has been the more depressing factor on the wheat markets, but both have had influence, though the over-burdening weight of the old crop and the necessity to clear some of the excessive visible supply before the new crop begins to move has probably been accountable for most of the fall in values."

At the close of the crop year, carryovers

of old-crop wheat appear to have been exceptionally large in Canada, about average in the United States and Argentina, somewhat low in Australia and western Europe, and distinctly low in eastern Europe. Stocks in the principal exporting countries and afloat were higher, in the main, than in 1927, while stocks in the principal importing countries were lower.

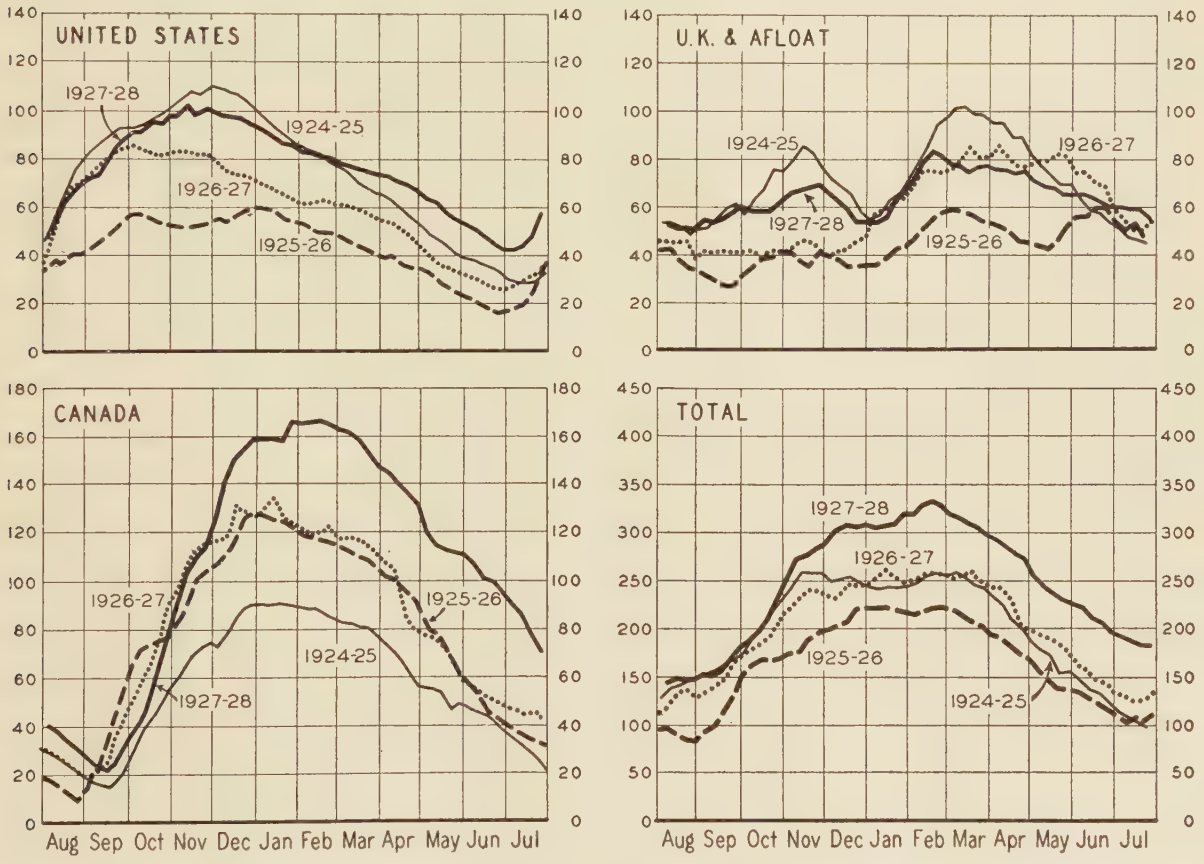
Visible Supplies

Data bearing chiefly on Northern Hemisphere visibles are summarized in Chart 1. From late November onward these supplies have run higher than in any other post-war year, even 1923–24. In mid-February combined visibles in the United States, Canada, United Kingdom ports, and afloat for Europe reached 330 million bushels, over 50 million higher than the previous peak of 275 million occurring in March 1924. The high figures of 1927–28 were due principally to the large size, late harvest, and rapid marketing of the Canadian crop, influences not counteracted by an export movement proportionately rapid.

The same factors that were operative in December–March kept United States visibles during April–June at the highest level for these months of any year since 1919.[1] The unusually large spring-wheat crop of 1927 made for very high visibles, for spring wheat tends to bulk larger in the visible

Chart 1.—Visible Wheat Supplies in the United States, Canada, and United Kingdom Ports and Afloat to Europe, Weekly from August 1924*

(Million bushels)



* Data from *Grain World, Northwestern Miller,* and *Canadian Grain Statistics.*

[1] See Wheat Studies, May 1928, IV, 248.

supply than winter wheat.[1] Exportation of wheat was unusually small, especially from ports east of the Rocky Mountains, the region to which the data on visible supplies apply. The high prices of April and May brought heavier farm marketing and larger receipts at primary markets than occurred during the corresponding period of any of the preceding four years.[2] The low point always reached before receipts of new-crop wheat become large came a little later this year, despite increased use of the combine, than in 1927 or 1926, but not so late as in 1925 and 1924. The increase during July was the largest of any July since the war except 1926.

Canadian visible supplies remained extraordinarily high throughout all of the last third of the year. The movement of wheat to export was heavy,[3] but not heavy enough to preclude a large and presumably burdensome carryover at the end of July. Visibles were reduced sharply in late April and early May, partly on account of the opening of lake navigation, as usual, but partly also as a result of exceptionally small receipts at Fort William and Port Arthur.[4] During late May Canadian visible supplies did not decline so rapidly as usual, since receipts were exceptionally large and the export movement was small. In July, however, large exports reduced the visible rapidly. Nevertheless, at the end of July the Canadian visible of 70 million bushels was still extraordinarily high by comparison with earlier years. The reduction from April 1 to August 1, some 77 million bushels, was distinctly large, being exceeded only by the reduction of 92 million bushels in 1924; but it was not so large as the record of past years seemed to suggest four months ago. At that time a larger Canadian export movement and a smaller outward carryover than reported figures show seemed probable; but until July importers apparently chose and were able to draw more heavily upon Argentina and Australia than seemed possible in the light of crop estimates and the mid-winter exports of those countries. The Canadian Pool appears not to have pressed its offers very freely in April and May, when prices were high and the outlook for new crops was mostly unfavorable, and hence an opportunity to cut down the huge visible was lost. Subsequently, however, offers appear to have been pressed, and exports in June were large and in July were of record size for the month.

Supplies afloat for Europe and in ports of the United Kingdom ran lower during April–June this year than last, as would be expected on account of the smaller shipments of March–May. In July, however, with shipments running higher than in 1927, these visibles were at an exceptionally high level for this time of year.

The effect of large visible supplies in the several positions was to maintain the total at record figures. Total visibles had been almost the largest of post-war years for the period April–July in 1927, only a little smaller than in 1924. This year, however, April–July visibles ranged approximately 50–60 million bushels higher than last, and during July averaged fully 16 per cent higher. These figures take no account of visible supplies in the Southern Hemisphere. A somewhat different compilation showing visibles in Argentina and Australia[5] gives the world total on August 1 as 227.5 million bushels. This figure was 46.5 million higher than that of 1927, and indeed the highest of post-war years by 35.3 million. But Argentine and Australian visibles, 5.9 and 9.5 million bushels, respectively, were not so high as last year's; and the ease of the international statistical position is slightly exaggerated by reference only to commercial stocks of the Northern Hemisphere.

[1] Heavy accumulations of spring wheat at Duluth and Minneapolis account for the high total visible this year. The following figures in thousand bushels (Chicago Board of Trade data) for June 30 of the past six years are pertinent:

Year	Duluth and Minneapolis	Total United States	Year	Duluth and Minneapolis	Total United States
1923	16,567	26,313	1926	4,511	12,325
1924	10,456	34,590	1927	8,316	22,107
1925	12,818	29,146	1928	23,116	38,922

[2] See Appendix Table III; cf. WHEAT STUDIES, September 1925, I, 358.

[3] See below, p. 376.

[4] See Appendix Table III; cf. WHEAT STUDIES, September 1925, I, 358.

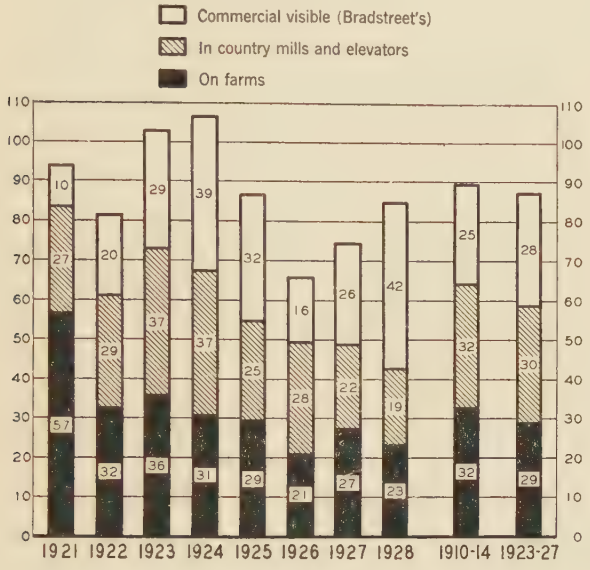
[5] See Appendix Table VII. The Argentine figures, however, are by no means an index of the supplies available for export in that country.

United States Stocks, June 30, 1928

A partial statement of the United States carryover at the end of the crop year is given in Chart 2, which shows the Department of Agriculture's estimates of stocks on farms and in country mills and elevators[1] together with Bradstreet's commercial visible. Stocks on farms were the lowest since 1921, except in 1926, presumably because high prices in April–May led to exceptionally heavy marketings. The exceptionally low stocks in country mills and elevators, only 18.9 million bushels as compared with a 5-year average of 29.9 million, were perhaps affected by the same factor.[2] But visible supplies as of June 30 were 42.2 million bushels, larger than in any year since the war. Hence the carryover consisting of these three items was 85 million bushels, some 10 million larger than that of 1927 and about average in size.

Chart 2.—Wheat Stocks in the United States, July 1, 1921–28, with Comparisons*

(Million bushels)



* Official data except Bradstreet's visible, as tabulated in Appendix Table VIII. Country mill and elevator figures for 1926–28 are estimated on a new basis, and probably are not strictly comparable with figures for earlier years.

A closer approach to the total United States carryover on June 30 is afforded by the addition of the Census Bureau's reports of stocks held by city mills. Data of the four years for which they are available are summarized in Table 2. Flour stocks were slightly higher than in any of the preceding three years. Wheat stocks of 46 million bushels were somewhat lower than those of 1927, but higher than those of 1925 and 1926, as were total stocks of 63 million. The total United States carryover calculated to include city mill stocks (except those in country elevators and public terminal elevators, in order to avoid duplication with country mill and elevator stocks and visible supplies elsewhere reported) reaches 142 million bushels. As compared with 138 million in 1927, 111 million in 1926, and 135 million in 1925, the figure does not appear remarkably high.[3]

Table 2.—United States Census Reports on Mill Stocks of Wheat and Flour, June 30, 1925–28

(Million bushels)

	1925	1926	1927	1928
Wheat:				
Country elevators	2.16	2.52	2.56	1.91
Public terminals	3.44	3.00	3.88	3.68
Private terminals, in transit, and in mills.	26.72	30.32	46.15	40.49
Total	32.31	35.83	52.59	46.08
Flour as wheat[a]	15.73	14.67	16.76	17.08
Grand total	48.04	50.51	69.35	63.16

[a] Barrels of flour converted at 4.7 bushels per barrel.

The appearance of fairly definitive figures on year-end stocks and net exports provides some ground for adjudging the accuracy of the official estimate of 1927. According to our calculations shown in Appendix Table XI, the residual ("feed and waste") item in disposition reached about 77 million bushels, as compared with 31 and 14 million in 1925 and 1926, respec-

[1] Estimates of stocks in country mills and elevators for 1926–28 appear not to be strictly comparable with the estimates for earlier years. See Wheat Studies, September 1927, III, 440.

[2] Apparently, however, the distribution of the crop among its various classes was also effective. Country mill and elevator stocks were exceptionally low in states east of the Mississippi, where the soft red winter-wheat crop of 1927 was distinctly small, rather than in states west of the Mississippi.

[3] Sydney Anderson, president of the Millers' National Federation, has calculated the total United States carryover as 175 million bushels. This calculation employs an uncertain figure (40 million bushels) for feed and waste.

tively. In our judgment the crops of 1925 and 1926 were underestimated, since the amounts of wheat available for feed and waste in the following crop years seem unbelievably low. The crop of 1927 seems clearly not to have been underestimated. It may have been slightly overestimated, as may the crops of 1923 and 1924. But the evidence is not altogether clear in the absence of definite estimates of wheat fed and wasted, and in the presence of some uncertainty respecting consumption and changes in unrecorded stocks.

Canadian Carryover, July 31

The outward carryover of Canadian wheat (exclusive of flour) on July 31 is officially placed at 76.5 million bushels in all positions.[1] This is by far the largest figure since data have been compiled, presumably the largest in history, and 26 million bushels larger than the heavy carryover of last year. Stocks in elevators and in transit, 67.3 million bushels, were distinctly large. The reduction in total stocks from the March 31[2] figure of 220 million bushels was apparently the largest of post-war years except 1924.

With the more important and variable of the several items of disposition now officially reported at least in preliminary form,[3] a notion may be obtained of the extent to which the Canadian crop of 1927 appears to have been officially underestimated. Net exports during the crop year totaled 332 million bushels; seed requirements and human consumption about 86 million; grain unmerchantable, lost in cleaning, and fed on farms about 49 million. These items, plus the outward carryover, total 542 million bushels. But according to official data, only 488 million bushels were available if the crop was 440 million and the inward carryover 48 million. Hence there is a discrepancy of 54 million bushels more or less which can be accounted for most reasonably on the hypothesis of an underestimated crop. The figures are subject to a margin of error, but the underestimate of the crop must have reached something like 40 to 60 million bushels. According to our calculations based chiefly on official data, underestimates of considerable magnitude have occurred in each of the past five years.

Southern Hemisphere Supplies, August 1

As of June 30, Argentine wheat stocks held in stations on the leading railways were directly estimated by the railway authorities as 1,384,000 tons. The *Times of Argentina*,[4] commenting on these figures, suggested that perhaps another million tons lay in ports and on farms. On this basis total stocks were in the neighborhood of 88 million bushels. Exports of 9 million bushels and domestic disappearance of some 5 million bushels (one-twelfth of our estimate for the quantity used for food and feed in 1927–28) may have brought the total stocks to about 74 million bushels on August 1. This figure is higher than our calculations of stocks for any of the preceding five years, which range from 56 to 67 million.[5] It does not necessarily imply, however, that August 1 stocks were exceptionally high this year; for our calculations have heretofore included no specific allowance for a carryover out of the Argentine crop year ending December 31, whereas the new estimate may be supposed to include this item. The data as they appear in the *Times of Argentina* do not lend themselves to thorough analysis because certain items are not fully described and there appears to be an arithmetical error. Nevertheless they suggest that Argentine stocks on August 1 were not distinctly below average, or below those of last year, as might be inferred from the exceptionally heavy exportation of January–July, but were of average size or above. If so, there is reason to believe that the crop of 1927 was officially underestimated, and that Argentine exports during August–December are not likely to prove exceptionally small. In our disposition table (p. 390) we have retained the stocks figure which results when stocks are calculated as a residual item in disposition;

[1] See Appendix Table VIII.

[2] Canadian wheat stocks as of March 31 are given in Wheat Studies, May 1928, IV, 265.

[3] See Appendix Table XI.

[4] The estimates are reproduced in the issue of July 16, 1928, p. 34.

[5] See Appendix Table XI.

at 37 million bushels, it seems considerably below the truth.

Australian stocks on August 1 were apparently somewhat lower than usual. Exports during January–July were heavier than seemed probable in view of the small crop and the record of earlier years. Stocks (calculated as the residual item in disposition) appear to have been about 35 million bushels as compared with 41 million a year ago, when the figure was exceptionally high.

European Stocks

Little is known definitely of European stocks either of import or domestic wheats at the end of the crop year. The *London Grain, Seed and Oil Reporter* of July 27 stated that "stocks of old wheat in Europe are believed to be very small." The situation presumably differs from country to country. Port stocks in the United Kingdom, 10.1 million bushels on August 1, were fairly high, about the same as last year. With the heavy shipments of July, it seems probable that continental stocks of import wheats must be of fair size. In Germany farm stocks of native wheat appear larger than last year, as has been true ever since the last harvest. Elsewhere in western Europe, however, stocks of domestic wheat are thought to be lower than a year ago; such is the case especially in Italy and France, where stocks on August 1, 1927, were exceptionally high. Poland, Czecho-Slovakia, and the Danube countries appear to have had small stocks for several months. The Russian situation is not clear, but it seems probable that stocks are moderate to low. Europe as a whole apparently carried somewhat smaller stocks out of 1927–28 than out of 1926–27; but the remaining reserves are probably not extraordinarily small except in central and eastern European countries.

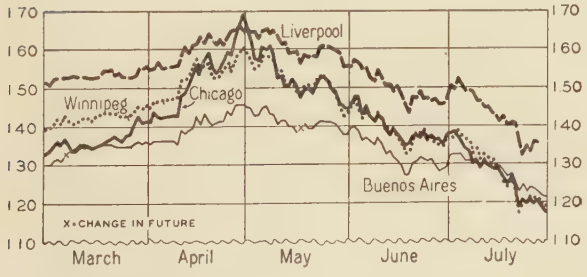
III. WHEAT PRICE MOVEMENTS

The Course of Prices

The last third of the crop year witnessed one of the most extreme recessions in wheat prices recorded since the crash of prices in 1920–21. Chart 3 shows the course of July futures prices on the world's leading markets (successive futures at Buenos Aires). From the peak of $1.69 per bushel on April 30, the July future at Chicago fell to a low point of $1.17 on July 31, a decline of 52 cents in three months. The widest April–July fluctuation of this future during the preceding five years occurred in 1925, when from April 3 to June 6 prices increased from $1.29 to $1.69 per bushel, or 40 cents in about nine weeks. A decline of equal magnitude in April–July had not been witnessed since the war, though it was less precipitous than the decline in February–March 1925. The recession was less drastic elsewhere than in Chicago.

Chart 3.—Daily Closing Prices of July Wheat Futures in Liverpool, Chicago, and Winnipeg, and of Successive Futures in Buenos Aires, March–July 1928*

(U.S. dollars per bushel)



* Data from *Chicago Journal of Commerce* and *Daily Trade Bulletin*, Chicago.

Two principal movements appear common to all markets. Throughout the month of April prices tended fairly steadily upward, continuing and accelerating a movement begun in February. From early May to the end of July the trend was distinctly downward except for a period of stability and slightly rising prices around June 20 to July 5.

The upward movement of April was due chiefly to accumulating evidence that winterkilling in the United States had been exceedingly heavy; a large proportion of the increase was registered during a few days following the official condition report issued April 11. Unfavorably cold weather, and drought in the southwestern states, contributed to the rise, especially to the

large gains recorded in the last three days of the month. Speculative activity ran high; the average daily volume of trading in United States markets during April, 66.2 million bushels, was the largest for any April since the war,[1] though well below the extremely high figures recorded in January–March and December 1925.[2] Unfavorable European crop reports were also a factor contributing to the advance of prices in April.

The beginning of the subsequent extensive decline occurred on May 1, when unofficial forecasts of American winter-wheat crops ran higher than had generally been expected. Profit-taking by "longs" probably was influential; and foreign markets had refused to follow at all closely the ten-cent bulge occurring at Chicago on April 27–30. The official report of condition and abandonment, issued May 9, occasioned a sharp decline on the following day; unfavorable though it was, it was less so than had been expected. Subsequently rains visited the southwest, and further declines occurred as prospects there improved. Reports of dry weather in the spring-wheat belt, however, supported the market during the second half of the month. Improving prospects for spring wheat, both in the United States and Canada, were the principal cause of the weakness of prices in the first half of June, though the heavy visible supplies also began to exert pressure. Stable or rising prices from about June 20 to July 5 were due in part to frequent rains hampering the winter-wheat harvest in the United States, and in part to reports that Russia had purchased for import large quantities of wheat in continental ports or afloat positions. But excellent crop prospects almost everywhere, hedging pressure, and the weight of visible supplies combined to force a precipitous decline throughout the remainder of the month, which continued in the first half of August.

As appears from Chart 3, the price movement was more extreme in Chicago than in Winnipeg, Liverpool, or Buenos Aires. Chicago prices rose 36 cents between March 1 and April 30; but Winnipeg prices rose only 21 cents, Liverpool only 15 cents (between March 2 and April 28), and Buenos Aires about the same as Liverpool. This development is explicable in view of the fact that the April crop outlook suggested to many the possibility that the United States might have no surplus of red winter or hard red spring wheat for export, and hence that domestic prices under tariff protection might stand high in relation to prices in foreign markets, as in 1925–26. With the huge Canadian visible in sight, traders outside the United States saw little reason to follow the Chicago movement to its full extent.[3] The spread between Chicago and Liverpool, Chicago and Winnipeg, and Winnipeg and Liverpool futures prices was gradually reduced. On April 30 the Chicago July future stood 4 cents above the Liverpool instead of 19 cents below, as had been the case two months before; and Winnipeg stood only 6 cents below Liverpool as against 12 cents below on March 1. The reduction in the Winnipeg-Liverpool spread was remarkable in the face of the huge Canadian visible.

On the decline of prices in May–July, the spread between both Winnipeg and Liverpool and Chicago and Liverpool widened steadily; but that between Chicago and Winnipeg did not. The change in crop prospects caused abandonment of the belief that the United States would not be able to provide representative wheats for export, and hence that the international statistical position might prove tight enough to justify high prices in 1928–29; the widening of the Chicago-Liverpool spread had to occur if export sales from gulf ports were to become possible.[4] The possibilities

[1] Cf. the following figures for April–July, 1924 to 1928, in million bushels:

Year	April	May	June	July
1924	18.0	14.4	34.0	53.3
1925	59.3	60.3	67.6	56.2
1926	55.8	48.8	46.3	57.5
1927	33.8	50.4	44.8	40.7
1928	66.2	56.6	36.2	39.8

[2] See WHEAT STUDIES, May 1928, IV, 253.

[3] Neither the Kansas City nor the Minneapolis markets followed Chicago fully; Kansas City prices rose 35 cents, Minneapolis prices 32 cents.

[4] It is generally understood that Liverpool futures prices must run appreciably above Chicago prices if export sales are to be feasible; but the precise size of the necessary spread is uncertain. Twenty cents is the figure most frequently spoken of by the trade; but the spread necessarily varies, of course, with changes in costs of handling and transportation.

that huge supplies would accumulate in the visible, and that hedging pressure would become severe if export sales were not made, were factors contributing to the decline of Chicago futures. The situation was complicated by the fact that, with improving crop prospects, the Canadian visible assumed an increasingly bearish aspect. Something in the nature of extraordinarily acute competition for export business occurred between Canada and the United States. Whereas in March–April, Chicago led in the upward movement of prices and Winnipeg followed with reserve, no reserve was shown by either market in the decline of May–July. It is seldom that the Winnipeg July future, based upon a deliverable grade of wheat which brings higher prices in cash markets than the grade deliverable at Chicago, sells at prices as low as the Chicago July future. Yet such was the case practically throughout May–July.[1] In effect Canadian wheats during most of the period could be purchased c.i.f. Europe at lower prices than comparable American wheats; and No. 3 Manitoba became cheaper than Argentine Rosafé wheat at Liverpool in June and July.[2] As a result of these price relationships, themselves due to changing crop prospects and the large supplies in Canada, Canadian exports were unusually heavy in June and July,[3] and little United States wheat appears to have been sold for export.

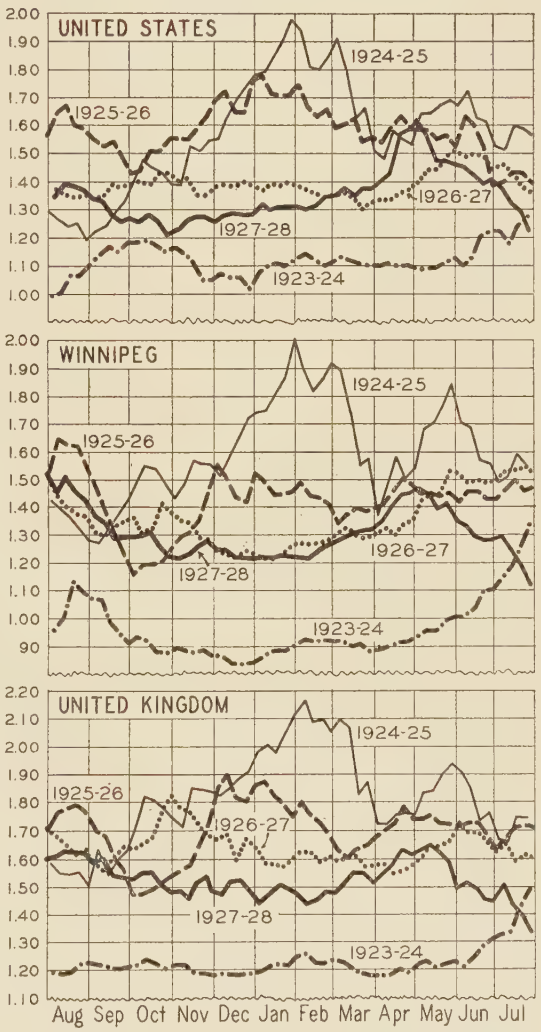
The Level of Prices

Chart 4 shows average weekly cash wheat prices in the United States, Winnipeg, and the United Kingdom for the past five years. For the year as a whole, the prices of 1927–28 now appear to have been the lowest since 1923–24 in all three countries, but most markedly so in the United Kingdom. Ocean freight rates have been lower this year than last, and United Kingdom prices of 1927–28 were therefore lower by comparison with those of 1926–27 than were prices in the United States and Canada. The April–July decline brought prices in all three markets to the lowest end-July figures in five years. Since August 1 prices have declined still farther, and the level now prevailing (August 25) is not far from the low post-war level maintained throughout most of the crop year 1923–24.

Certain contrasts with the situation in the last four months of 1926–27 are of

Chart 4.—Weekly Average Cash Prices of All Classes and Grades of Wheat in Five Principal United States Markets, of No. 3 Manitoba Northern in Winnipeg, and of Sales of Parcels of All Classes of Wheat in the United Kingdom, from August 1923*

(U.S. dollars per bushel)



* Data from *Crops and Markets, Canadian Grain Statistics,* and *London Grain, Seed and Oil Reporter.* United States prices are weekly weighted averages for six markets since the first week in January 1927.

[1] The situation was not entirely without precedent, however. In 1923–24 the Winnipeg July future sold below the Chicago July from November until early June, though not in June and July.

[2] See Appendix Table IX.

[3] See below, p. 376, and Appendix Table V.

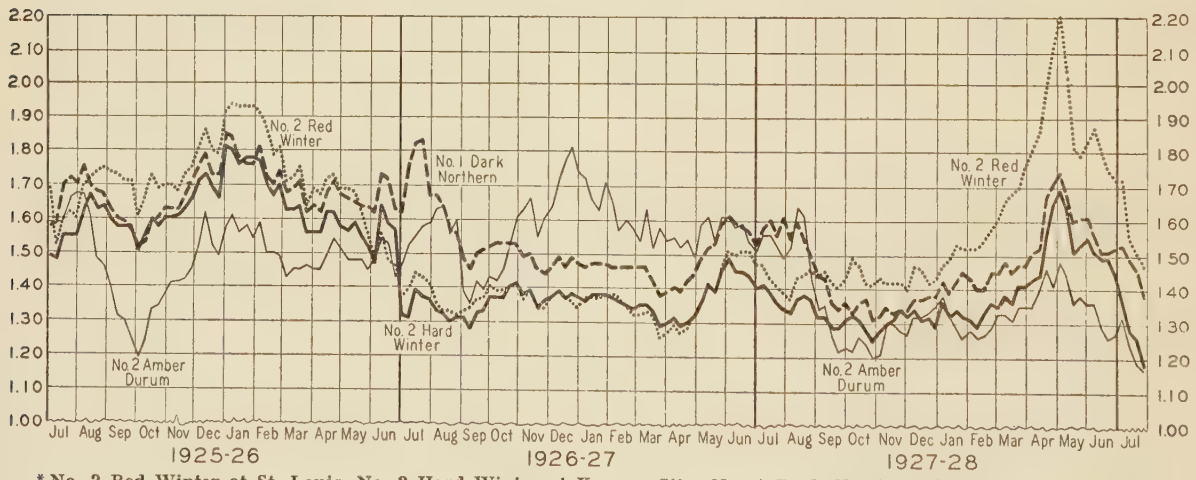
interest. April prices in the United States this year were far above those of April 1927, but in Canada the difference was less marked, and in the United Kingdom still less. This illustrates the greater weight given to the United States crop outlook at home than abroad, and suggests that the American price movement was by no means purely speculative and confined to transactions in futures, because cash wheat prices behaved in much the same manner. July prices of 1928 fell farther below those of 1927 in Canada than in the United Kingdom, and in the United Kingdom than in Chicago. Last year Canadian prices ruled relatively high because of the great uncertainty of crop prospects in that country, and rose while American and British prices were declining.

United States Cash Prices

Neither the Chicago July futures price series shown in Chart 3 (p. 369) nor the weighted average United States cash price series shown in Chart 4 (p. 371) serves fully to portray wheat price movements in the United States. Weighted weekly averages of the prices of four different grades and types of wheat are shown in Chart 5 for the past three years. The extraordinary premiums of No. 2 Red Winter wheat over the other types are of special interest. Throughout the year (after the harvesting of spring-wheat crops in September 1927) red winter wheat sold at a considerable premium on account of the short crop. In February, March, and April the premium widened rapidly, because the heavy winterkilling had occurred principally in the regions producing soft red winter. From the beginning of March to the peak about May 1, No. 2 Red Winter advanced 59 cents per bushel in price, while No. 2 Hard Winter advanced only 34 cents and the Chicago July future (see Chart 3, p. 369) only 36 cents. The peak of soft red winter prices in early May, $2.20 per bushel, was higher even than the unusual figures reached in January 1926 and January 1925,[1] previously the highest figures recorded since the crash of wheat prices in 1920. The May–July decline in prices was more extreme for soft red than for hard red wheat; but at the end of July, with the new crop practically assured, soft red still sold for nearly 30 cents a bushel more than hard red winter wheat. As usual in July, the two grades of winter wheat have shown movements different from the two grades of spring wheat. Red winter wheat seems certain, in view of the extraordinary short crop, to continue to sell at a premium over other types in 1928–29.

Chart 5.—Weekly Average Cash Prices of Typical Wheats in United States Markets, from July 1925*

(U.S. dollars per bushel)



* No. 2 Red Winter at St. Louis, No. 2 Hard Winter at Kansas City, No. 1 Dark Northern Spring, and No. 2 Amber Durum at Minneapolis. Data from *Crops and Markets.*

[1] See Wheat Studies, November 1925, II, 42.

Relationships of Near and Distant Futures

Certain features of the price relationships of near and distant futures during April–July are of interest, especially at Chicago and Winnipeg. Relevant data are shown in Chart 6.

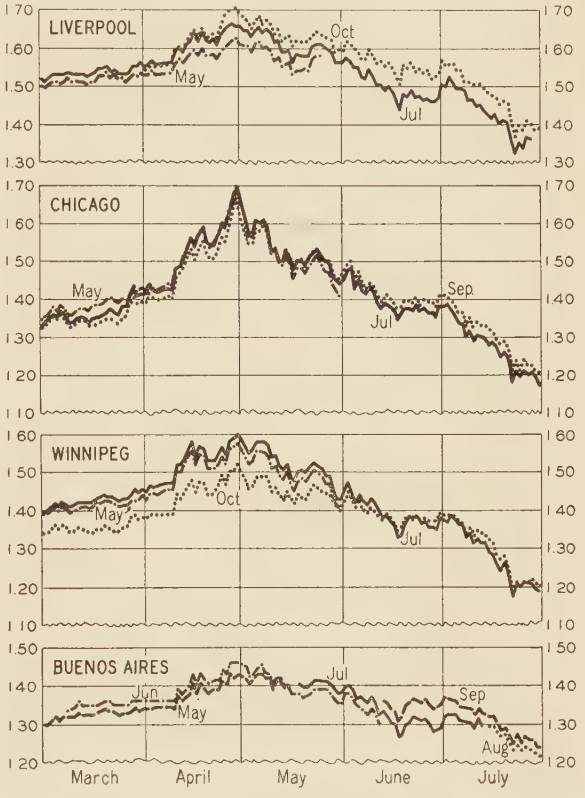
In Liverpool the nearer future consistently ran below the July and closed below it as well; the July future (except for a brief period in early April) likewise ran below and closed below the October. These relationships are apparently normal for years when ample supplies are immediately available and the situation is not expected to change materially.[1] For a period in late June and early July, the July future sold at a somewhat larger discount under the October than was true in earlier and later weeks; at this time the distant futures responded the more sharply to reports of unfavorably wet weather in the American southwest and of Russian grain purchases.

One unusual feature of futures price relationships at Chicago was the small and diminishing discount of the July under the May as prices rose in March–April, and the closing of the May below the July. It is difficult to speak with precision of the normal relationships of May and July futures at Chicago, since the July appears to be more of a new-crop future in one year, and more of an old-crop future in another; and hence a carrying charge between the two may or may not be present. Apparently, however, unfavorable crop prospects caused the July future to advance more rapidly than the May in March–April; but in the subsequent decline the May future lost more heavily because it was affected by the high visible supplies. High visible supplies appear not to have been regarded as especially burdensome while the new-crop prospect was poor, but they became so when the crop outlook was reversed. To this factor seems attributable also the most unusual circumstance of a September future selling at a premium over the July and even the May.

In Winnipeg the July option sold near or below the October throughout June and July—again a most unusual occurrence.

Chart 6.—Daily Closing Prices of Principal Wheat Futures in Four Leading Markets, March–July 1928*

(U.S. dollars per bushel)



* Data from *Chicago Journal of Commerce* and *Daily Trade Bulletin*, Chicago.

The July option is always an old-crop future at Winnipeg, while October is always a new-crop future; since it involves no carrying charge, the October future ordinarily sells below the July. Here also the heavy visible supplies seem not to have been regarded as burdensome until it became fairly clear that the North American crop would prove distinctly large; thereafter they became very burdensome indeed.

[1] Nevertheless spreads between near and distant futures might have been smaller had there not been exceptionally large accumulations of stocks of Argentine wheat at Liverpool. See the *Revue du Marché* of J. A. Goldschmidt & Co. (Paris) for May 9, 1928, quoting a letter from Ross T. Smyth & Co. of London. This letter stated that Liverpool stocks approximated 4 million bushels, and that under existing spreads between May and July futures, the wheat could be carried at a profit for delivery on July options.

IV. INTERNATIONAL TRADE

Volume and Course of Trade

As most observers had expected, international trade in wheat and flour continued fairly heavy during the last third of the crop year. As shown by Table 3, Broomhall's shipments for 18 weeks reached 268 million bushels, a figure much above average for this period and exceeded only twice since the war—last year and in 1924. The movement throughout the year has been more regular than in any other of the past six years except 1922–23. Shipments during April–July averaged about 15 million bushels a week, as compared with about 16 in December–March and about 15 in August–November 1927. Last year high ocean freight rates in September–December restricted the August–November movement and swelled the December–March and April–July totals. In 1925–26 and 1923–24 large European wheat crops made the August–November movement unusually small. In 1924–25 the April–July movement was restricted in view of prevailing high prices and a favorable European crop outlook.

Table 3.—International Wheat and Flour Shipments (Broomhall) by Destination*

(Million bushels)

Year	April–July (18 weeks)			August–July (52 weeks)		
	Total	To Europe	To ex-Europe	Total	To Europe	To ex-Europe
1920–21..	235.3	214.6	20.8	591.0	541.5	49.5
1921–22..	206.1	181.3	24.8	647.1	546.7	100.4
1922–23..	231.7	200.7	31.0	676.4	585.9	90.5
1923–24..	283.3	246.0	37.2	775.3[a]	626.5[a]	148.8[a]
1924–25..	188.2	169.3	19.0	715.2	639.7	75.5
1925–26..	225.4	190.0	35.4	667.6	532.3	135.3
1926–27..	282.5	233.3	49.2	814.4	682.4	132.0
1927–28..	268.2	218.0	50.2	792.8	661.8	131.0
Average						
1909–14..	218.2	189.7	28.5	624.7	542.7	82.0
1922–27..	242.2	207.8	34.4	729.8	613.4	116.4

* Data from Broomhall's *Corn Trade News.*

[a] Fifty-three weeks.

The course of trade is roughly indicated in Chart 7, in terms of 3-week moving averages of weekly shipments for each of the past six crop years. This year, shipments fell off rather sharply with rising prices during April. There was no marked increase with the opening of navigation on the Great Lakes on May 4, though huge stocks of Canadian grain were available for shipment. During May, European importers apparently restricted their purchases somewhat in view of declining prices and increasingly favorable crop prospects in North America, and Canadian wheat was not yet offered in large quantities. Shipments during June and July, and especially in July, were exceptionally large for this period of the year. Prices had already fallen to a much lower level than prevailed in late April and early May; European importers bought freely as the decline progressed; and with new-crop prospects increasingly good, Canadian wheat was pressed for sale. Spot prices of No. 3 Northern Manitoba at Liverpool fell below the prices of Argentine Rosafé.[1] Under these influences the course of shipments remained more nearly uniform than might have been expected from the record of past years; the May–June peak was flattened, while the June–July decline was less pronounced than usual.

Sources of Exports

One of the striking features of the trade during April–July was the unusual distribution of exports, as shown by Table 4 (p. 376). While the total was about what we forecast in our last survey,[2] the distribution of exports from the several exporting countries was different. Less wheat and flour was shipped from the United States, Canada, and India than seemed probable four months ago; and more was shipped from Argentina and Australia. India's shipments in April–July were 3.6 million bushels, almost the smallest since 1922; they were relatively small because the crop harvested in March–June turned out to be considerably smaller than preliminary estimates indicated. As was expected, shipments from Russia and the Danube countries, especially Russia, were very small, though the data given in the table do not show under

[1] See Appendix Table IX.

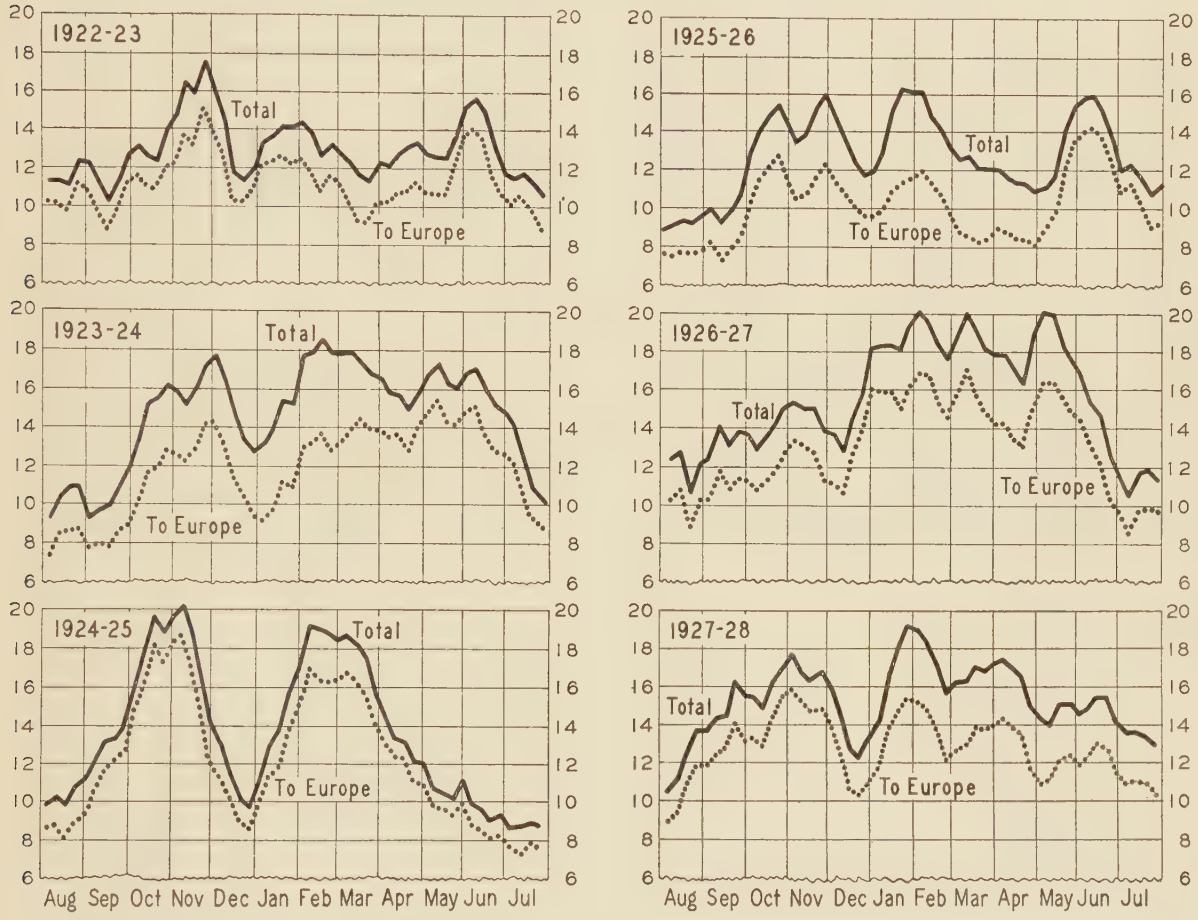
[2] See Wheat Studies, May 1928, IV, 238 f.

shipments from the Danube some 7.2 million bushels shown by another tabulation of Broomhall's as shipped from that source. Although Russian exports by land are not yet reported, it seems probable that Russia has been a net importer rather than a net exporter, at least for April–July and possibly for the crop year as a whole. Purchases (simultaneously effected in several widely scattered countries of continental Europe) were made early in July. According to conflicting opinions of the trade, these purchases may have ranged anywhere from 7 to 18 million bushels. The group designated by Broomhall as "other countries" made shipments of 10.9 million bushels, the largest quantity in the past eight years. This also was in accord with anticipations based upon good crops in Chile and the French dependencies in northern Africa; but the figures given apparently include some shipments from Russia and the Danube countries in several years.

Shipments from Argentina were of exceptional size, reaching 74.3 million bushels in the last 18 weeks of the year. This is the largest figure of the past eight years except 1924. It is exceptional not because of a small crop, but because December–March shipments were also of record size for the period, and even from the relatively large crop so heavy an April–July movement had seemed unlikely unless stocks were to be reduced to distinctly low figures. Net exports during January–July

CHART 7.—INTERNATIONAL SHIPMENTS OF WHEAT AND FLOUR, WEEKLY FROM AUGUST 1922*

(Million bushels: 3-week moving average)



* Broomhall's data, from the *Corn Trade News*.

totaled 147 million bushels from an estimated crop of 239 million; for the same period in 1924, out of the supposedly larger crop of 248 million, net exports were 138 million or 9 million bushels less. Since stocks appear not to have been at all low on August 1,[1] the evidence suggests that the crop of 1927 was underestimated. European importers were thus able to draw more freely upon Argentine supplies than seemed possible four months ago. Hence, in spite of a need for large imports, they were not compelled to bid very actively for the more readily perceptible supplies available (but for a time, in April and May, firmly held) in Canada. Australia also seems to have shipped wheat freely in April–July, but there is as yet no evidence that the crop was underestimated; on the contrary, stocks there appear to have been reduced.

During June and July, perhaps somewhat earlier, the huge Canadian stocks came to be much more freely offered in consequence of excellent new-crop prospects and the reversal in the outlook for 1928–29. As Table 4 shows, net exports from Canada totaled 106 million bushels during April–July, the highest figure of post-war years, though not much above that recorded in 1924. But April and May net exports, though large, were not so large as in either 1927 or 1924, while June and July net exports were of record size—71 million bushels. July exports of 35 million bushels were by far the largest of post-war years, over 70 per cent higher than the previous record of 20.7 million bushels in July 1926. Presumably more wheat would have left Canada in April and May and in the April–July period had not lake navigation opened rather late. But the more important restricting factor was probably the combination of circumstances which enabled European importers to purchase freely from the Southern Hemisphere instead of accepting firm Canadian offers.

Net exports from the United States during April–July were distinctly small, totaling only 26.3 million bushels, smaller even than the low post-war figure of 1924. April–June exports reached only 21.2 million bushels, a somewhat lower figure than had seemed probable in view of relatively large visible supplies. July net exports of 5.1 million bushels were very small, much below those of 1926, when the winter-wheat harvest was earlier. Some 15.4 million bushels of the April–July exports consisted of flour; some 4.0 million bushels consisted of wheat from the Pacific coast; and a good deal of the balance was probably durum. Very little soft or hard red winter or hard red spring was exported, and only negligible quantities of new-crop winter wheat were exported from gulf ports in July. Large

[1] See above, p. 368.

TABLE 4.—INTERNATIONAL SHIPMENTS AND NET EXPORTS OF WHEAT AND FLOUR FROM PRINCIPAL EXPORT AREAS, APRIL–JULY, 1921–28*

(Million bushels)

April–July	International shipments (Broomhall's)							Net exports	
	Total	North America	Argentina	Australia	Russia, Danube	India	Other[a]	United States	Canada
1921	235.3	146.9	37.8	46.5	1.2	2.9	...	112.8	31.7
1922	206.1	106.1	60.5	36.9	1.9	.0	.7	55.7	47.8
1923	231.7	131.8	60.6	16.1	2.8	18.5	2.0	45.1	66.2
1924	283.3	143.6	86.7	30.0	7.4	12.0	3.5	28.4	103.0
1925	188.2	104.1	30.8	44.4	.0	4.4	4.5	44.0	54.2
1926	225.4	139.1	42.1	22.4	11.0	3.6	7.2	46.5	84.0
1927	282.5	141.7	71.1	48.7	8.5	7.5	5.1	51.4	82.8
1928	268.2	145.4	74.3	33.7	.2	3.6	10.9	26.3	106.4

* Shipments are for 18 weeks, from Broomhall's *Corn Trade News*. Net exports are official data.

[a] In several years, apparently includes some shipments from Russia and the Danube basin. In another table Broomhall gives the following distribution, in million bushels, for 1926–27: Russia, 8.0; Danube, 5.6; North Africa and Chile, .4; for 1927–28: Russia, 0.0; Danube, 7.2; North Africa and Chile, 4.8.

July exports from the gulf ports were apparently prevented by relatively lower prices of Canadian wheat; but the small total exports of April–June are less easy to explain. Exports of hard red spring seldom occur in these months; exports of soft and hard red winter have been almost negligible during the winter and spring because of prevailing high prices. Hence it seems probable that April–June exports fell somewhat below our expectations expressed in April[1] because excellent new crops of durum wheat in northern Africa and Italy restricted the demand for that variety.

Advance Estimates and Reported Movements

Although official statistics of net exports and imports for the past crop year are as yet incomplete, enough evidence has accumulated to permit brief comment upon the accuracy of advance estimates of international trade made earlier in the year.

This year the international movement has not provided so many surprises as in 1926–27. Advance estimates made in the course of 1926–27 on the whole proved rather inaccurate. As late as December 14 Broomhall estimated probable shipments for the year (August–July) at 736 million bushels; reported shipments were 814 million. Our own December estimate of probable net exports, 790 million bushels, was exceeded by about 60 million bushels. The center of the range of the United States Department of Agriculture's December estimate of July–June net exports (727–870 million bushels) was 798 million bushels. This year there appears to have been a much smaller discrepancy between advance estimates and reported movements than occurred last year.

Table 5 shows Broomhall's successive estimates of shipments for the crop year in comparison with reported shipments. Broomhall's first estimate was 772 million bushels; in common with most observers, he anticipated a smaller movement than that of 1926–27 because wheat and rye crops of European importing countries appeared to be somewhat larger. On April 17 he raised his estimate to 792 million bushels, on the basis of import statistics then available and evidence that European crops had proved rather poorer in quality than had been anticipated; as the table shows, the estimate of shipments to Europe was raised by 32 million bushels, while estimated shipments to ex-Europe were lowered by 12 million. Subsequent changes in estimates were small, and reported shipments of 793 million bushels fell very close to his April forecast.

Table 5.—Broomhall's Successive Estimates of Shipments for 1927–28 Compared with Reported Shipments*

(Million bushels)

Exporting area	December 20	April 17	June 12	Reported shipments
North America..	488	496	496	490
Argentina	160	168	168	178
Australia	60	64	72	74
Russia	8	8	5	5
Danube basin ..	36	36	28	29
India	12	12	8	7
Other countries.	8	8	12	10
Total	772	792	789	793
To Europe	632	664	661	662
To ex-Europe ..	140	128	128	131

*Data from Broomhall's *Corn Trade News*.

As shown by Table 6 (p. 378), the center of the range of probable net exports estimated by the Department of Agriculture was 826 million bushels on November 21, 1927; 830 million on April 18, 1928; and 829 million on June 14, 1928. While the range was successively reduced, there was little change in the center of the range. Our own estimates also changed only slightly in aggregate amount. Reported net exports for August–July now appear to have fallen somewhat below both of our advance estimates,[2] by some 8 million bushels.

It is possible that more complete information will show a smaller discrepancy.

[1] See Wheat Studies, May 1928, IV, 241.

[2] We have not attempted to compare July–June net exports with the Department of Agriculture's advance estimates. As we have frequently had occasion to point out (see especially Wheat Studies, IV, No. 9, pp. 312, 340), Broomhall's shipments have appeared to fall below official data on net exports at least in recent years. It is probable that they do not fall so far below this year as last if, as seems likely, Russian exports overland were smaller this year than last.

The net exports shown in Table 6 are known, or can be estimated within a small margin of error, for all countries but Russia. But whether Russia is to be classified as a net exporting country in 1927–28 is not yet certain. It seems reasonably clear that Russian exports during the crop year were not large—probably not over 10 million bushels.[1] If, as many traders appear to believe, Russian import purchases reached 9 or 10 million bushels, and if all of this wheat passed the border before the end of July, for the year as a whole imports may practically have equaled exports or Russia may have been a net importer. If subsequent information should show that Russia was in fact a net exporter, total net exports may more closely approximate our advance estimates. Certain of our estimates of net exports from other countries may also be in error, but probably not enough to alter the discrepancy appreciably.

TABLE 6.—FOOD RESEARCH INSTITUTE AND U.S.D.A. ADVANCE ESTIMATES OF NET EXPORTS OF WHEAT AND FLOUR FOR 1927–28, COMPARED WITH REPORTED EXPORTS*

(Million bushels)

Exporting area	U.S.D.A.			F.R.I.		Reported
	Nov. 21	April 18	June 14	Dec. 20	Apr. 20	
United States.	220–245	210–230	190–210	225	205	191
Canada	300–330	310–340	305–330	317	343	332
Argentina ...	120–170	140–170	175–185	151	156	178[a]
Australia	55–80	55–80	70–80	74	65	69[a]
Russia	5–30	7–15	6–7	20	10	...[b]
Danube basin	22–41[c]	22–44	25–37[d]	30[d]	35[d]	35[de]
India	5–10	8–10	9–12	8	10	7[f]
Others	3–16[g]	3–16	3–15[g]	...	5[h]	9[i]
Total	730–922	755–905	783–876	825	829	821

* U.S.D.A. estimates are for years ending June 30. F.R.I. estimates and reported exports are for years ending July 31, except United States figures which are for years ending June 30.

[a] July net exports estimated from Broomhall's shipments.

[b] Data not available; exports may have been balanced by imports.

[c] Roumania, Bulgaria, and Hungary. Jugo-Slavia possibly on importing basis.

[d] Roumania, Bulgaria, Hungary, and Jugo-Slavia.

[e] Net exports from Hungary in August–June, Roumania in August–March, and Jugo-Slavia in August–April, totaling 29 million bushels, plus an estimate of 6 million bushels for exports not yet reported from these countries and from Bulgaria.

[f] Partially estimated from gross exports, net exports, and Broomhall's shipments.

[g] Algeria and Chile.

[h] North Africa, Chile, and Uruguay.

[i] Net exports from Algeria, August–June, were 4.67 million bushels. The total includes our tentative estimate of net exports from Morocco, Chile, and Uruguay for the crop year, and from Algeria in July.

In a sense the close correspondence of advance estimates and reported movements was fortuitous; totals were forecast with reasonable accuracy, but in distribution there were fairly large errors. Most of the latter were due in part to imperfections in the earlier data on exportable supplies. Thus reported net exports from the United States proved lower than our April estimate and lower than the middle of the range of the Department of Agriculture's estimate. This we are tentatively disposed to attribute in part to a possible overestimate of the crop, not perceptible until the year's data on exports and stocks were complete.[2] Argentine net exports of 178 million bushels were larger than either Broomhall, the Department of Agriculture, or ourselves regarded as probable even so late as mid-April. The evidence now suggests that the crop was officially underestimated.[3] Canada's net exports of 332 million bushels fell below our April estimate of 343 million partly because navigation opened late on the Great Lakes, but partly because of the situation which permitted importers to obtain unexpectedly large supplies from Argentina. Since Canadian holders did not press sales until June and July, Canadian stocks available on March 31 were not reduced so rapidly by export as the experience of past years suggested, and the carryover proved higher than we anticipated.[4] Australia's net exports also exceeded expectations slightly; apparently stocks were reduced to a rather low level. Statistical data are still too deficient to warrant definitive statements respecting net exports of India, Algeria, Morocco, Chile, and Uruguay. It may be said, however, that the Indian crop estimates current in April justified an estimate of net

[1] Broomhall's shipments totaled 5 million bushels for the year; but official net exports totaled 5.2 million in August–November alone. Presumably some wheat not recorded by Broomhall was exported overland; but it seems probable that the quantity could not have been large.

[2] See above, pp. 367 f. Another factor, already mentioned (p. 377) was probably restricted demand abroad for durum.

[3] See above, p. 368.

[4] See WHEAT STUDIES, IV, 241 f.

exports higher than was reasonable after the revised estimate appeared. The excellent new crop of Algeria made for larger exports in April–July than seemed probable as late as mid-April. The accumulating evidence on available exportable supplies was thus of a compensatory sort; necessary reductions in probable exports from some countries were counterbalanced by increases elsewhere, so that the total movement proved about as large as observers anticipated.

In default of complete statistics of net imports for the crop year, it is premature to attempt any close comparison of net imports with forecasts. Table 7 shows, however, our December advance estimates for leading European countries in comparison with reported net imports of earlier years and reported net imports for eleven months of 1927–28. The picture may be considerably altered when net import data for July become available. But it seems certain that net imports of the United Kingdom will fall below our December estimate of 240 million bushels, probably by about 15 million bushels. Italy also appears likely to import less than seemed probable earlier, although March–June net imports were exceptionably large.[1] Except Germany as well, the other countries listed in the table bid fair to import a little or considerably more wheat than seemed likely earlier in the year, and (France excepted) more than was imported in 1926–27.

TABLE 7.—NET IMPORTS OF WHEAT AND FLOUR BY LEADING EUROPEAN COUNTRIES, AUGUST–JUNE 1927–28, WITH COMPARISONS*

(Million bushels)

Importing area	Average 1922–27	1925–26	1926–27	F.R.I. Dec. estimate 1927–28	Aug.–June 1927–28
British Isles[a] ..	225.0	209.9	237.0	240	204.1
Italy	85.7	67.7	86.6	100	80.1
Germany	59.7	57.4	91.8	100	82.4
France	45.9	10.3[b]	62.0	45	43.6
Belgium	39.5	39.2	39.5	40	38.2
Netherlands ..	26.6	27.2	28.4	29	29.3
Scandinavia[c] ..	22.2	18.8	19.6	20	24.4
Switzerland ..	15.9	15.6	16.3	17	17.0
Czecho-Slov'kia	18.9	21.7	20.1	19	20.1
Total	539.4	467.8	601.3	610	539.2

* Data from official sources and International Institute of Agriculture.

[a] Includes Irish Free State.

[b] International Institute figure for 1925–26 adjusted for wheat imported under decree of December 30, 1924. See WHEAT STUDIES, May 1926, II, 211 n. Figure for 1926–27 probably too low.

[c] Norway, Sweden, Denmark.

V. OUTLOOK FOR THE NEW CROP YEAR

WHEAT AND RYE CROPS OF 1928

In its broad outlines, the wheat supply situation in the Northern Hemisphere is perhaps clearer than usual at this season; yet details are unusually obscure. At the date of writing (August 25) official forecasts and estimates of production are available for fewer countries than was the case a year ago,[2] but there is less uncertainty regarding the distribution of crops and its significance. Table 8 (p. 380) gives this distribution for the past nine years; figures in roman type are official or predominantly so, whereas figures in italics represent estimates which rest more largely on our own approximations based upon recorded production in past years, trade estimates, and available information on crop progress in recent weeks.

Exporting countries of the Northern Hemisphere, India and Russia excepted, seem reasonably certain to be assured of exceptionally large crops. If the Canadian crop approximates 550 million bushels, Canada and the United States combined have a crop of some 1,440 million, about 125 million more than in 1927, and certainly the largest in history except possibly the bumper crop of 1915. The contrast with the crops of 1925–27 is probably not so marked as the figures suggest, since there is reason to believe that official Canadian estimates were too low in each of these years, and official United States estimates were probably too low in 1925 and 1926, but not in 1927.[3] With the huge carryover in Canada and the moderately high carryover in the United States, there is little doubt that

[1] See Appendix Table V.

[2] See Appendix Table I; cf. a similar table in WHEAT STUDIES, September 1927, III, 446.

[3] See Appendix Table XI.

North America has the largest exportable surplus since 1915, possibly in history.

The crop of the exporting countries of the Danube basin, about 360 million bushels, is the largest since the war, and seems to exceed that of 1927 by over 80 million bushels. Northern Africa also appears to have harvested a record post-war crop; and the increase is concentrated in the exporting countries of Morocco, Algeria, and Tunis. India alone among the exporting countries has clearly harvested a small crop, the smallest since the war except for the very low outturn of 1921. Even the approximate size of the Russian crop is unknown as yet, though recent indications suggest that it may equal or exceed the fair crop of 1927.

European importing countries appear likely to harvest a crop somewhat smaller than that of 1927, but not so small as those of 1924 and 1926. The French, English, German, Spanish, Portuguese, and Polish crops now seem distinctly smaller than those of 1927, the Italian and Greek distinctly larger; but the situation is still obscure with respect to outturns in England, Germany, and Poland, where harvest returns may alter the outlook considerably. There is reason to anticipate distinctly better quality of wheat in the leading importing countries of western Europe than prevailed in 1927. Italian quality was good last year, and is probably equally good this year. And in France, Germany, England, and other countries of northwestern Europe the harvest appears not to have been hampered by excessive rains such as occurred in August last year, and quality on the whole may be expected to prove better even if abnormally heavy rains come in September. Hence it is likely that the importing countries of Europe will have larger domestic supplies of good milling wheat this year as compared with last, even if the total quantity harvested proves smaller. The favorable weather of July and August, moreover, may lead to upward revisions of production estimates; and only a few such would suffice to raise the 1928 production of wheat in importing countries of Europe above that of 1927.

The European rye crop, however, promises to prove small. Official estimates of rye production in 10 European countries, together with the United States Department of Agriculture's forecasts for production in Germany and Poland, total 525 million bushels in comparison with 598 million harvested in these countries in 1927. The corn and potato crops also appear to be smaller, barley and oats larger.

Japan and Chosen together have appar-

TABLE 8.—WHEAT PRODUCTION IN PRINCIPAL PRODUCING AREAS, PRE-WAR AND POST-WAR*

(Million bushels)

Year	United States	Canada	Soviet Russia	Lower Danube[a]	Other Europe	North Africa	India	Japan, Chosen	Northern Hemisphere ex-Russia	Argentina	Australia	Southern Hemisphere	World ex-Russia
1920.....	833	263	...	172	775	71	378	41	2,550	156	146	350	2,900
1921.....	815	301	...	212	1,004	98	250	40	2,727	191	129	376	3,103
1922.....	868	400	...	224	815	72	367	40	2,801	196	109	354	3,155
1923.....	797	474	...	260	989	107	372	35	3,051	248	125	427	3,478
1924.....	864	262	...	204	846	85	361	35	2,670	191	165	407	3,077
1925.....	676	395	713	296	1,094	105	331	40	2,949	191	115	359[b]	3,308[b]
1926.....	831	407	810	294	909	90	325	39	2,906	221	161	436[b]	3,342[b]
1927.....	873	440	750	278	981	106	334	38	3,063	239	109	415[b]	3,478[b]
1928.....	891	*550*	...	360	*960*	*110*	290	42	*3,225*	...	...	...	.....
Average													
1909–13...	690	197	759[c]	330	1,018	92	352	32	2,724	147	90	280	3,004
1923–27...	808	396	757[d]	266	964	98	344	37	2,928	218	135	409	3,337

*Summarized from most recent official data for individual countries (see Appendix Table I), as reported by the U.S. Department of Agriculture, supplemented by our own estimates. Totals exclude China, Asia Minor, Brazil, and a number of small producers. All estimates are for territory within post-war boundaries. Figures in italics are made up predominantly from unofficial forecasts and advices.

[a] Hungary, Bulgaria, Roumania, Jugo-Slavia.

[b] Includes our estimate for Peru.

[c] Regarded as too low by Soviet officials, whose estimate is 908 million bushels.

[d] Three-year average.

ently harvested slightly the largest crop in post-war years, though the Japanese crop is of poor quality. The situation in China, where domestic wheat production is of considerable significance because of its effect on the total volume of ex-European trade, is not clear. But observers report that one of the largest crops in recent years, of good quality, has been secured in the lower Yangtze valley, and that prices at Shanghai are the lowest since 1924,[1] when the Chinese crop also appears to have been distinctly large. Trade reports suggest that crops in Asia Minor are distinctly small.

The Northern Hemisphere wheat crop, of around 3,225 million bushels exclusive of Russia, China, and Asia Minor, now seems to be the largest of post-war years. It appears to be about 160 million bushels larger than the next largest crop, that of 1927, on the basis of official data which for 1927 seem slightly too low. Its large size is due chiefly to crops average or better everywhere except in India, and of record size in Canada. If it were possible to include Chinese and Russian crops in the comparison, the Northern Hemisphere crop of 1928 would probably compare even more favorably with that of 1927.

The Statistical Position

Apparently none of the preceding few years has witnessed a distribution of Northern Hemisphere wheat crops sufficiently similar to that of 1928–29 to warrant drawing close analogies. Supplies in European importing countries are probably less adequate than in 1923–24, especially if weight is given to the smaller rye crop and to growth of population and increases in per capita consumption over the interval of years. India certainly has a smaller crop than in 1923. On the other hand, North America and the Danube countries clearly have larger supplies. By comparison with 1927–28, European importing countries perhaps have equally adequate supplies, of wheat though not of rye, while North America and the Danube countries have more wheat to export and India less. The year 1923–24 was a year in which the international statistical position was distinctly easy; in 1927–28 somewhat the same situation prevailed, though to a less marked degree. The wheat crops of 1928 are so much larger than those of 1927 in North America, the Danube countries, and northern Africa, and so little smaller in the importing countries of Europe, that the international statistical position bids fair to prove easier than in 1927–28, though probably less easy than in 1923–24.

For the year as a whole, much depends upon the final outturn in the Southern Hemisphere. Thus far weather conditions and reports of acreage suggest crops of more than average size in Australia and Argentina. If such crops are harvested, they will be larger than the crops of 1927–28, and possibly larger than the crops of 1923–24. A distinctly poor crop in the Southern Hemisphere would probably suffice to tighten the statistical position only slightly, since North American supplies are so large; but a distinctly good crop might ease it further.

A fairly easy statistical position for the crop year 1928–29 now seems assured, even in the face of possible crop reversals. A distinctly easy position, not greatly different from that of 1923–24, appears probable. A tight position like those of 1924–25 and 1925–26 seems highly unlikely. Under these circumstances the wheat market bids fair to continue to be a buyer's market, at least until new-crop prospects begin to exert influence toward the spring of 1929.

International Trade

If our analysis of the international statistical position is approximately correct, certain effects upon international trade and prices during 1928–29 may be anticipated with reasonable assurance. European importing countries regarded as a group probably enter the crop year 1928–29 with smaller stocks of old-crop wheat than they held at the beginning of 1927–28. Their crops of rye, potatoes, and corn appear to be smaller this year than last, and this circumstance may cause more extensive substitution of wheat. Their millable wheat crops are perhaps as large as those of 1927.

[1] See U. S. Department of Agriculture, *Foreign News on Wheat*, July 10, 1928.

Their population increases, and per capita consumption seems to be increasing in some countries. On the whole it seems probable that larger imports may be "needed," and still larger imports recorded, in 1928–29 than in 1927–28. If the level of wheat prices proves lower than in 1927–28, wheat consumption both for food and feed may be expected to increase somewhat from this cause alone; this would be the result implied in an easier international statistical position. Hence we anticipate larger net exports to Europe in 1928–29 than in 1927–28. In this view we differ from Broomhall, who on August 7 estimated probable shipments to Europe (or imports of Europe—the distinction is not drawn in Broomhall's calculations) as 640 million bushels, against 662 million shipped to Europe in 1927–28.

Since India has a small crop following three crops of only moderate size, and must be classified as a net importing country in 1928–29, exports to ex-Europe may be swelled over those of 1927–28 by 15–30 million bushels from this cause alone. In most ex-European countries, population and per capita consumption of wheat are apparently increasing. Egypt has a smaller crop this year than last, and some countries of Asia Minor perhaps need larger imports. All of these circumstances make for distinctly larger exports to ex-Europe than in 1927–28. But the Oriental trade bulks large in total ex-European trade, and annual variations in total exports to ex-Europe appear to depend largely upon the Chinese crop. China had a good crop in 1924, and exports to China were very small; but wheat prices were high. She had a poor crop in 1923, and exports to China were very large; but wheat prices were low. This year the combination of circumstances is different: the Chinese crop appears to be large, and prices promise to rule low. It may be that exports to Japan and China will fall below rather than above those of 1927–28; even so, any such decline will hardly counterbalance increased exports to India and other ex-European countries. Hence we anticipate larger exports to all ex-Europe in 1928–29 than were made in 1927–28. But so considerable an increase as Broomhall expects (184 million bushels in 1928–29 as against 131 million in 1927–28) we regard as unlikely on the basis of past experience.[1]

Hence exports both to Europe and to ex-Europe, and in total, now promise to exceed last year's. It is too early in the season to fix upon definite figures. Net exports of record size were recorded in 1926–27, when the total reached about 850 million bushels. In that year European countries had smaller crops of wheat but larger crops of rye than present estimates suggest for 1928–29; the principal exporters had smaller wheat crops. There is little doubt that exportable surpluses in total will prove higher in 1928–29 than in 1926–27. The volume of trade will presumably prove higher also unless stocks are built up to extraordinary heights in exporting countries, or unless domestic utilization for food and feed proves extraordinarily large in exporting countries. Some building up of stocks, especially on farms in the United States, may reasonably be expected; but that Canadian stocks should be greatly increased seems improbable, and the record of past years does not suggest that changes in Argentine and Australian stocks are ever large in absolute amount. There seems little reason to suppose that increased stocks or increased consumption in exporting countries will together prove quantitatively as large as the increased exportable surpluses; consequently increased exports will presumably occur. If so, 1928–29 may witness the largest international movement of wheat and flour in history.

Certain details of the general movement may also be foreseen. Exports from Canada will probably prove of record size; as in 1927–28, relatively large shipments will presumably be made from the Pacific ports because of the good crop in Alberta. Exports from the United States bid fair to consist more largely of hard red winter wheat, as compared with last year; even less soft red winter is available, the durum and hard red spring crops are little larger, and the Pacific states have smaller crops. The Danube countries and the exporting countries of northern Africa, with crops of

[1] For more detailed discussion of ex-European trade in recent years, see WHEAT STUDIES, August 1928, IV, No. 9, esp. pp. 338–45.

record post-war size, will probably export exceptionally large quantities. India bids fair to draw considerable wheat from Australia in the winter months. To what extent wheat deficiency countries may be expected to increase consumption of wheat at a relatively low price level is conjectural, especially in view of the unclear position of other foodstuffs for which wheat serves as substitute.

Prices

Crop developments in the last four months suggest that the general level of wheat prices characteristic of the crop year has probably already been fixed below the level of 1927–28, and even more below the levels of 1924–25, 1925–26, and 1926–27. A sustained rise in prices to a higher level than that of 1927–28 seems possible only in the event of a near crop failure in Argentina and/or Australia; and at present no such occurrence can reasonably be anticipated. During August, prices have closely approached the lowest post-war level maintained through most of 1923–24. Radical shifts from current levels now seem improbable, at least until next spring. Continued excellent progress of the later Northern Hemisphere crops might cause slight declines from the level of mid-August, and poor progress might cause slight increases; but further changes in crop prospects in the Northern Hemisphere seem unlikely to exert great influence unless Russia should spring a surprise. The good prospects in the Southern Hemisphere appear thus far not to have affected the markets appreciably. If these prospects are borne out by the harvests, the unusual concurrence of large crops in all the major wheat-exporting countries could result in world prices below the level of 1923–24, even though Europe's demand will be stronger than it was six years ago. A serious reversal, such as occurred in Argentina in 1925, would have the opposite effect. With the statistical position already easy, there is reason to suppose that price fluctuations, especially in the winter months, will prove relatively small.

As a consequence of the short crop, soft red winter wheat in the United States will doubtless carry high premiums, as in 1925–26 and 1927–28. Some Pacific white wheat will presumably move by rail to the central United States, reducing supplies available for export from Pacific ports. Durum wheat is likely again to be sold at a considerable discount. Premiums for protein content on hard red spring wheat bid fair to rule lower than was the case in 1927–28; but higher protein premiums on hard red winter, now prevailing, are likely to be maintained.

The higher grades of Canadian wheat now promise to command smaller premiums than in 1926–27 and 1927–28, since the harvest is proceeding somewhat earlier and under more favorable conditions. Under the weight of heavy visible supplies, the relationships of near and distant futures in Liverpool, Winnipeg, and Chicago promise to furnish some interesting developments.

This study is the work of M. K. Bennett, with the advice of Joseph S. Davis and Alonzo E. Taylor, and the aid of Janet Murray and Katharine Merriam

APPENDIX

TABLE I.—WHEAT PRODUCTION IN PRINCIPAL PRODUCING AREAS, 1920–28*

(Million bushels)

Year	United States	Canada	India	Australia	Argentina	Chile	Uruguay	Hungary	Bulgaria	Jugo-Slavia	Roumania	Soviet Russia	Mexico
1920	833.0	263.2	377.9	145.9	156.1	23.2	7.8	37.9	30.0	43.0	61.3	.....	15.0
1921	814.9	300.9	250.4	129.1	191.0	23.6	10.0	52.7	29.2	51.8	78.6	.....	5.1
1922	867.6	399.8	367.0	109.5	195.8	25.9	5.2	54.7	32.6	44.5	92.0	.....	13.6
1923	797.4	474.2	372.4	125.0	247.8	28.1	13.3	67.7	29.1	61.1	102.1	.....	13.7
1924	864.4	262.1	360.6	164.6	191.1	24.5	9.9	51.6	24.7	57.8	70.4	.....	10.4
1925	676.4	395.5	331.0	114.5	191.1	26.7	10.0	71.7	41.4	78.6	104.7	713.0	9.4
1926	831.0	407.1	324.7	160.8	220.8	23.3	10.2	74.9	36.5	71.4	110.9	809.6	10.3
1927	872.6	440.0	333.8	109.9	239.2	33.5	13.9	76.9	47.3	56.6	96.7	749.6	11.5
1928	891.3	.....	289.8	.....	.....	....	....	89.5	51.1	105.4	113.9	.....	11.0
Average													
1909–13	690.1	197.1	351.8	90.5	147.1	20.1	6.5[a]	71.5	37.8	62.0	158.7[a]	758.9[b]	11.5[a]
1923–27	808.4	395.8	344.5	135.0	218.0	27.2	11.5	68.6	35.8	65.1	97.0	757.4[c]	11.1

Year	Morocco	Algeria	Tunis	Egypt	British Isles	France	Germany	Italy	Belgium	Netherlands	Denmark	Norway	Sweden
1920	17.9	16.2	5.2	31.7	56.8	236.9	82.6	141.3	10.3	6.0	7.4	1.00	10.3
1921	23.2	28.5	9.0	37.0	73.8	323.5	107.8	194.1	14.5	8.6	11.1	.97	12.3
1922	12.9	18.9	3.7	36.6	65.2	243.3	71.9	161.6	10.6	6.2	9.2	.64	9.5
1923	20.0	35.8	9.9	40.7	58.4	275.6	106.4	224.8	13.4	6.2	8.9	.59	11.0
1924	28.7	17.3	5.2	34.2	53.9	281.2	89.2	170.1	13.0	4.7	5.9	.49	6.8
1925	23.9	32.7	11.8	36.2	53.7	330.8	118.2	240.8	14.5	5.6	9.7	.49	13.4
1926	16.2	23.6	13.0	37.2	52.2	231.8	95.4	220.6	12.8	5.5	8.8	.59	12.2
1927	24.8	28.3	8.3	44.3	57.2	276.1	120.5	195.8	16.3	5.1	9.4	.60	11.3
1928	....	35.1	11.9	....	44.8[d]	.....	.....	235.2	....	6.0	....	....	....
Average													
1909–13	17.0	35.2	6.2	33.7	59.6	325.6	131.3	184.4	15.2	5.0	6.3	.31	8.1
1923–27	22.7	27.5	9.6	38.5	55.1	279.1	105.9	210.4	14.0	5.4	8.5	.55	10.9

Year	Spain	Portugal	Switzerland	Austria	Czecho-Slovakia	Poland	Finland	Latvia	Esthonia, Lithuania	Greece	Japan, Chosen	South Africa	New Zealand
1920	138.6	10.4	3.6	5.4	26.4	22.7	.27	.39	2.58	11.2	41.1	7.6	6.9
1921	145.1	9.3	3.8	6.5	38.7	37.4	.58	.78	3.34	10.3	39.8	8.7	10.6
1922	125.5	10.0	2.5	7.4	33.6	42.4	.71	.96	4.17	9.0	39.2	6.3	8.4
1923	157.1	13.2	3.8	8.9	36.2	49.7	.69	1.64	3.70	8.8	34.7	6.0	4.2
1924	121.8	8.6	3.1	8.5	32.2	32.5	.79	1.58	3.86	7.7	35.3	7.1	5.4
1925	162.6	12.1	3.5	10.7	39.3	57.8	.93	2.16	6.08	11.2	40.0	7.8	4.6
1926	146.6	8.6	4.2	9.4	34.1	47.1	.92	1.86	5.02	11.2	38.9	9.0	8.0
1927	144.8	11.4	4.3	11.9	40.4	54.2	.81	2.64	6.35	13.3	40.4	6.6	9.2
1928	141.1	6.6	...	12.0[e]	....	....	.83	....	....	16.5	41.5	...	...
Average													
1909–13	130.4	11.8[f]	3.3	12.8	37.9	63.7	.14	1.48	3.63	16.3[f]	32.0	6.0[f]	6.9
1923–27	146.6	10.8	3.8	9.9	36.4	48.3	.83	1.98	5.00	10.4	37.9	7.3	6.3

* Data of U.S. Department of Agriculture. For 1909–13, including U.S. Department of Agriculture estimates for area within post-war boundaries. Dots (....) indicate that data are not available.

[a] Four-year average.

[b] Regarded as too low by Soviet officials, whose estimate is 908 million bushels.

[c] Three-year average.

[d] England and Wales only.

[e] Official estimate for winter wheat plus an allowance for spring wheat.

[f] One year only.

TABLE II.—WEEKLY WHEAT RECEIPTS AT PRIMARY MARKETS IN THE UNITED STATES AND CANADA*

(Million bushels)

Month	United States				Fort William and Port Arthur				Vancouver			
	1925	1926	1927	1928	1925	1926	1927	1928	1925	1926	1927[a]	1928[a]
Apr.	2.90	2.61	3.78	5.48	1.30	.51	.83	.48	.14	1.19	1.15	2.78
	1.80	3.27	3.49	4.42	.74	.68	.64	.23	.38	1.10	1.27	1.96
	2.84	2.79	2.98	4.48	.77	.52	.59	.26	.24	.93	.54	2.77
	1.95	3.52	3.41	4.17	3.50	.29	4.34	.26	.28	.69	.77	2.92
May	2.85	3.75	3.28	4.07	3.08	.18	6.86	.09	.44	.86	.94	2.81
	3.19	3.51	3.60	4.86	2.33	2.17	6.42	.25	.49	.56	.34	2.41
	2.88	3.09	3.89	6.70	1.12	4.00	3.87	3.13	.43	.35	.14	1.95
	5.19	3.60	5.20	7.46	1.09	4.75	2.96	6.56	.39	.22	.49	1.45
	5.45	4.83	4.92	4.83	1.68	5.13	2.82	4.72	.34	.07	.50	1.39
June	5.75	3.68	4.93	4.32	.90	4.89	2.49	4.22	.28	.06	.23	1.56
	4.83	3.71	4.09	3.87	.83	2.81	1.99	4.54	.38	.04	.11	.72
	4.61	3.51	4.03	3.10	.89	2.94	1.48	5.08	.21	.04	.17	1.21
	5.02	5.67	4.15	2.89	1.01	2.74	1.33	4.38	.03	.08	.18	.64
July	4.95	8.80	7.65	4.24	1.33	1.95	1.33	4.93	.05	.05	.06	.46
	7.59	13.79	8.54	7.40	1.80	2.04	2.07	4.28	.05	.10	.07	.69
	7.75	14.25	10.35	14.24	1.90	1.63	2.89	3.14	.06	.06	.04	.50
	11.67	19.26	11.35	18.76	1.31	1.19	3.10	3.07	.03	.01	.02	.46
		25.25	26.01	23.93		.92	2.61	3.03	.03	.05	.00	.72

* United States data are unofficial figures compiled from *Grain World;* Fort William and Port Arthur data are official figures for *net* receipts furnished by Canadian Board of Grain Commissioners; Vancouver data are official figures compiled from *Canadian Grain Statistics.* United States and Fort William and Port Arthur data begin with figures for weeks ending April 4, 1925, April 3, 1926, April 2, 1927, and March 31, 1928; Vancouver figures are for weeks ending one day earlier.

[a] Receipts at Prince Rupert included.

TABLE III.—MONTHLY WHEAT RECEIPTS AT PRIMARY MARKETS IN THE UNITED STATES AND CANADA FROM AUGUST 1924*

(Million bushels)

Month	United States primary markets				Fort William and Port Arthur				Vancouver			
	1924–25	1925–26	1926–27	1927–28	1924–25	1925–26	1926–27	1927–28	1924–25	1925–26	1926–27	1927–28
Aug.	93.0	43.3	71.6	81.6	1.3	1.2	1.5	2.4	.21	.55	.12	.09
Sept.	82.1	57.9	48.7	79.7	7.1	45.7	32.8	8.6	.41	.28	.29	.32
Oct.	88.0	36.1	37.1	73.2	40.9	53.2	56.1	51.4	3.98	7.04	6.37	6.17
Nov.	60.5	34.1	29.8	44.8	42.7	51.5	60.5	71.0	5.05	9.79	7.22	10.78
Aug.–Nov.	323.6	171.4	187.2	279.3	92.0	151.6	150.9	133.4	9.65	17.66	14.00	17.36
Dec.	36.3	34.9	22.4	26.5	20.3	53.5	26.3	41.0	4.21	6.14	6.63	11.81
Jan.	24.7	21.6	24.6	23.5	4.1	10.5	14.0	21.1	3.84	10.03	6.83	16.49
Feb.	19.9	16.2	21.0	22.5	6.2	4.0	8.6	9.5	2.08	7.74	4.27	12.54
Mar.	17.3	15.1	16.6	26.3	8.5	3.2	6.3	3.3	.74	6.98	5.94	10.50
Dec.–Mar.	98.2	87.8	84.6	98.8	39.1	71.2	55.2	74.9	10.87	30.89	23.67	51.34
Apr.	10.4	14.0	14.4	17.9	8.1	1.8	12.6	.9	1.02	3.58	3.58	10.88
May	17.6	15.7	19.2	25.9	7.0	17.2	17.3	17.6	1.54	1.20	1.56	7.43
June	21.9	21.0	20.7	15.5	4.1	13.6	7.3	20.1	.74	.22	.61	3.66
July	41.8	77.0	58.8	....	6.7	6.4	10.7	14.4	.11	.27	.14	2.44
Apr.–July	91.7	127.7	113.1	....	25.9	39.0	47.9	53.0	3.41	5.27	5.89	24.41
Aug.–July	513.5	386.9	384.9	....	157.0	261.8	254.0	261.3	23.93	53.82	43.56	93.11

* United States data are unofficial figures compiled from *Survey of Current Business;* Canadian data are official figures from *Reports on the Grain Trade of Canada* and *Canadian Grain Statistics.* Vancouver figures include receipts at Prince Rupert after October 1, 1926.

TABLE IV.—WEEKLY WHEAT AND FLOUR SHIPMENTS BY AREAS OF ORIGIN AND DESTINATION, APRIL–JULY, 1928*

(Million bushels)

Week ending	North America	Argentina, Uruguay	Australia	Russia	Danube	India	Other countries	Total	To Europe	To ex-Europe
Apr. 7	8.02	5.99	2.30	...	.14	.02	.39	16.86	13.49	3.37
14	8.93	6.94	1.21	...	...	...	.58[a]	17.66	15.32	2.34
21	8.73	5.48	1.65	...	...	.04	.41[b]	16.31	12.86	3.45
28	6.91	5.79	2.22	...	...	...	.37	15.29	12.03	3.26
May 5	8.24	2.33	1.50	...	.03	.38	.50	12.98	9.87	3.11
12	5.58	4.50	3.34	...	...	.08	.67[a]	14.17	11.01	3.16
19	8.88	2.72	2.50	...	...	...	.69[b]	14.79	12.57	2.22
26	8.52	3.78	3.05	...	...	.09	.50	15.94	12.76	3.18
June 2	8.78	2.68	1.77	...	...	.09	.86	14.18	11.72	2.46
9	8.39	3.65	.66	...	...	.25	.54	13.49	11.25	2.24
16	8.57	5.75	.86	...	...	.70	.73[a]	16.61	14.05	2.56
23	6.67	4.17	3.06	...	...	1.00	.89	15.79	13.41	2.38
30	6.62	3.36	2.66	...	...	.22	.64	13.50	10.58	2.92
July 7	7.65	2.89	1.70	.01	...	.12	.66[a]	13.03	10.41	2.62
14	9.23	3.01	.75	...	...	.31	.73[a]	14.03	11.59	2.44
21	8.36	2.51	1.55	...	...	.33	.82[c]	13.57	11.05	2.52
28	9.60	1.71	.67	...	...	.02	.54	12.54	10.09	2.45
Aug. 4	9.07	.99	1.11	...	.04	.17	.80	12.18	10.23	1.95

* Here converted from data in Broomhall's *Corn Trade News*. Broomhall's weekly figures do not always check with his cumulative totals, which presumably include later revisions. Shipments from "other countries" apparently include a part of the shipments from the Danube and Russia in most weeks.

[a] Includes 20 thousand bushels shipped from Chile.
[b] Includes 10 thousand bushels shipped from Chile.
[c] Includes 30 thousand bushels shipped from Chile.

Table V.—International Trade in Wheat and Flour, Monthly from July 1927*

(Million bushels)

A.—Net Exports

Month	United States	Canada	India	Australia	Argentina	Roumania	Hungary	Jugo-Slavia	Poland	Algeria	Tunis	Egypt
July	11.6	8.6	5.12[a]	8.1	9.9	.56	1.26	.06	(.42)[b]	(.26)[b]	(.10)[b]	(.47)[b]
Aug.	27.5	14.5	1.57[a]	4.1	5.9	1.34	2.99	.23	(.08)[b]	.51	(.09)[b]	(.51)[b]
Sept.	39.0	17.1	.81[a]	4.2	5.4	1.88	3.28	.16	(.10)[b]	.26	(.18)[b]	(.56)[b]
Oct.	34.7	23.4	.74	2.3	5.3	1.14	2.57	.15	(.45)[b]	(.19)[b]	(.27)[b]	(.60)[b]
Nov.	24.8	57.9	.79[a]	1.6	5.0	1.24	2.26	.22	(.58)[b]	.56	(.02)[b]	(.64)[b]
Dec.	10.2	49.1	.35[a]	2.3	8.7	.95	1.71	.18	(.64)[b]	.16	(.03)[b]	(.52)[b]
Jan.	11.1	18.6	.25[a]	9.3	24.1	.29	1.14	.00[c]	(.21)[b]	.34	.00[d]	(.57)[b]
Feb.	5.0	21.8	(.60)[b]	6.4	29.7	.16	1.46	(.09)[b]	(.09)[b]	.54	(.02)[b]	(.59)[b]
Mar.	5.8	23.7	.41[a]	9.1	31.6	.25	1.87	(.13)[b]	(.07)[b]	.52	(.04)[b]	(.60)[b]
Apr.	7.4	11.1	.48[a]	7.3	21.3	....	1.42	(.16)[b]	(.47)[b]	.70	(.06)[b]	(.49)[b]
May	6.7	34.2	.68[a]	9.5	14.9	....	1.54	...	(2.47)[b]	.65	...	(.66)[b]
June	7.1	25.2	2.50	8.6	16.5	....	.96	...	(2.04)[b]	.63	...	(.42)[b]
July	5.1	35.9	....	...	....	....	....	...	....	....	....	...

B.—Net Imports

Month	Irish Free St.	United Kingdom	France	Germany	Belgium	Italy	Netherlands	Scandinavia	Switzerland	Czecho-Slovakia	Baltic States[e]	Japan
July	1.70	17.33	10.00	10.19	3.62	7.59	2.02	2.06	1.43	1.56	.63	1.16[a]
Aug.	1.10	20.78	7.74	6.48	3.50	3.92	2.10	1.86	1.45	2.26	.57	.27[a]
Sept.	1.82	19.59	7.20	6.96	3.67	2.96	2.80	2.35	1.30	1.62	.70	.34[a]
Oct.	1.70	15.18	5.14	9.23	4.12	3.04	3.39	2.18	1.67	1.82	.78	.24
Nov.	2.24	19.13	5.33	8.96	3.60	4.86	3.60	2.45	2.05	1.80	.81	.89[a]
Dec.	1.93	15.74	3.93	8.06	3.62	6.19	2.96	2.89	1.80	2.83	.42	.89[a]
Jan.	1.34	6.78	3.02	7.84	3.02	7.45	2.30	1.77	2.28	1.35	1.16	1.90[a]
Feb.	1.55	14.85	2.80	6.11	2.95	6.98	2.02	1.89	1.59	1.30	.59	1.55
Mar.	1.54	23.61	2.13	6.99	3.94	9.33	2.96	2.39	1.68	2.12	.77	2.55[a]
Apr.	1.64	16.80	2.02	8.88	3.56	11.98	2.11	2.40	1.43	1.95	.70	2.33[a]
May	.50	17.03	1.82	6.88	2.62	13.74	2.19	2.26	1.05	1.98	.64[f]	3.53[a]
June	1.64	17.59	2.47	6.00	3.64	9.60	2.86	1.94	.70	1.02	.70[f]	1.38
July	....	19.36	....	....	....	....	....	...	....	....	....	...

* Data from official sources and International Institute of Agriculture.

[a] Gross, not net.
[b] Net import.
[c] Net export of 500 bushels.
[d] Net export of 3,300 bushels.
[e] Finland, Esthonia, Latvia.
[f] Excluding Latvia.

Table VI.—Weekly Visible Supplies of Wheat in North America, United Kingdom, and Afloat, April–July, 1928*

(Million bushels)

Date	United States	Canada	U.K. ports	Afloat to Europe	Total	Date	United States	Canada	U.K. ports	Afloat to Europe	Total
Apr. 7	71.9	144.5	7.2	68.4	292.0	June 2	52.5	109.7	10.0	55.0	227.2
14	69.9	140.2	7.4	68.3	285.8	9	50.6	106.4	9.6	55.7	222.3
21	68.2	136.1	7.2	67.1	278.6	16	47.1	100.9	9.8	54.3	212.1
28	66.2	131.9	8.8	66.4	273.3	23	44.2	99.5	9.4	52.7	205.8
						30	42.2	94.2	10.4	50.2	197.0
May 5	63.7	119.7	9.6	61.7	254.7						
12	61.7	113.8	8.4	60.3	244.2	July 7	42.2	89.6	10.6	49.5	191.9
19	58.1	112.0	7.6	60.3	238.0	14	43.3	85.6	9.8	50.0	188.7
26	54.7	110.9	7.6	56.3	229.5	21	47.6	76.3	10.2	49.1	183.2
						28	57.1	69.7	10.4	44.7	181.9

* United States data from *Bradstreet's;* Canadian data from *Canadian Grain Statistics;* U.K. and afloat data from Broomhall's *Corn Trade News.* Canadian figures are for days preceding dates indicated in the above table, and are adjusted to bring stocks in western country elevators into the correct week.

TABLE VII.—WORLD VISIBLE WHEAT SUPPLIES, AUGUST 1, 1920–28, AND MONTHLY, 1927–28*

(Million bushels)

Date	United States	Canada	Argentina	Australia	United Kingdom ports	Afloat to Europe	North America	Argentina, Australia	U.K. and afloat	Grand total	Total ex-Australia
1920 Aug. 1	42.7	8.2	3.7	27.5	12.8	76.2	50.9	31.2	89.0	171.1	143.6
1921 Aug. 1	56.2	8.9	3.7	30.0	7.6	57.9	65.1	33.7	65.5	164.3	134.3
1922 Aug. 1	43.1	19.3	2.2	3.0	7.1	48.9	62.4	5.2	56.0	123.6	120.6
1923 Aug. 1	73.3	14.1	4.4	18.0	8.2	39.0	87.4	22.4	47.2	157.0	139.0
1924 Aug. 1	72.1	31.6	6.8	30.0	9.9	41.8	103.7	36.8	51.7	192.2	162.2
1925 Aug. 1	57.3	23.4	7.7	8.4	9.2	33.3	80.7	16.1	42.5	139.3	130.9
1926 Aug. 1	64.2	28.3	4.1	6.2	4.3	38.6	92.5	10.3	42.9	145.7	139.5
1927 Aug. 1	65.9	42.7	5.9	12.7	7.8	46.1	108.6	18.6	53.9	181.1	168.3
Sept. 1	108.7	27.4	4.8	9.7	10.4	44.0	136.1	14.5	54.4	205.0	195.3
Oct. 1	143.7	22.2	4.4	6.8	10.0	50.0	165.9	11.2	60.0	237.1	230.3
Nov. 1	156.0	72.0	3.6	3.0	8.6	56.1	228.0	6.6	64.7	299.3	296.3
Dec. 1	154.7	120.9	3.6	.7	9.6	57.1	275.6	4.3	66.7	346.6	345.9
1928 Jan. 1	143.4	157.8	3.7	41.0	8.0	46.1	301.2	44.7	54.1	400.0	359.0
Feb. 1	128.9	162.8	8.0	51.0	6.4	65.5	291.7	59.0	71.9	422.6	371.6
Mar. 1	118.6	156.5	11.8	43.5	5.8	66.9	275.1	55.3	72.7	403.1	359.6
Apr. 1	110.1	146.6	12.8	36.0	7.7	68.4	256.7	48.8	76.1	381.6	345.6
May 1	97.8	131.1	11.0	24.5	9.8	65.7	228.9	35.5	75.5	339.9	315.4
June 1	75.1	107.3	9.9	26.0	10.1	55.0	182.4	35.9	65.1	283.4	257.4
July 1	61.1	95.6	7.7	19.5	10.4	50.2	156.7	27.2	60.6	244.5	225.0
Aug. 1	88.1	69.2	5.9	9.5	10.1	44.7	157.3	15.4	54.8	227.5	218.0
Average, Aug. 1											
1910–14	58.8	10.8	1.3	5.9[a]	15.4	35.2	69.6	7.2[a]	50.6	127.4[a]	121.5
1923–27	66.5	28.0	5.8	15.1	7.9	39.7	94.5	20.9	47.6	163.0	147.9

*A joint compilation by Broomhall, the *Daily Market Record*, Minneapolis, and the *Daily Trade Bulletin*, Chicago, here summarized from Broomhall's *Corn Trade News* and the *Daily Trade Bulletin*. Includes some flour stocks.

[a] For Australia, 4-year average, 1911–14.

TABLE VIII.—UNITED STATES AND CANADIAN CARRYOVERS OF WHEAT, 1919–28*

(Thousand bushels)

Year	United States (July 1)				Canada (August 31, 1919–23; July 31, 1924–27)				
	Total	On farms	In country mills and elevators	Commercial visible (Bradstreet's)	Total	On farms	In elevators	In transit	In flour mills
1919	49,806	19,261	19,672	10,873	.....[a]	2,149	3,305	.....[a]	.....[a]
1920	110,254	49,546	37,304	23,404	.....[a]	2,122	6,930	.....[a]	238
1921	93,840	56,707	27,167	9,966	13,727	2,144	4,831	6,032	720
1922	81,457	32,359	28,756	20,342	20,590	2,360	11,024	4,578	2,628
1923	102,414	35,894	37,117	29,403	11,690	1,441	5,051	2,758	2,440
1924	106,204	30,981	36,626	38,597	45,159[b]	7,363[c]	27,400[b]	5,856[b]	4,539[b]
1925	86,447	29,357	25,287	31,803	26,483	2,709	17,939	3,835	2,000
1926	65,949	20,973	28,490	16,486	35,601	3,987	25,451	3,163	3,000
1927	74,507	27,215	21,776	25,516	50,586	4,264	37,079	5,243	4,000
1928	84,514	23,450	18,856	42,208	76,484	4,186	53,570	13,728	5,000
Average									
1910–14	89,411	32,485	31,600	25,326	.....[a]	.....[a]	.....[a]	.....[a]	.....[a]
1923–27	87,164	28,884	29,919	28,361					

* Bradstreet's visible, and official data of U.S. Department of Agriculture and Dominion Bureau of Statistics. See especially *Agriculture Yearbooks*, *Canada Yearbooks*, *Grain World*, and press releases.

[a] Not available.

[b] July 31, as for later years.

[c] For 1924 quantities in farmers' hands relate to August 31; for subsequent years to July 31.

TABLE IX.—WEEKLY CASH PRICES OF REPRESENTATIVE WHEATS IN LEADING EXPORTING AND IMPORTING MARKETS, MARCH–JULY, 1928*

(U.S. dollars per bushel)

Month	United States				Canada		Argentina	Liverpool					
	No. 2 Red Winter (St. Louis)	No. 2 Hard Winter (Kansas City)	No. 1 Dark Northern (Minneapolis)	No. 2 Amber Durum (Minneapolis)	No. 1 Manitoba (Winnipeg)	No. 3 Manitoba (Winnipeg)	Spot (Buenos Aires)	No. 1 Manitoba	No. 3 Manitoba	Pacific White	No. 2 Winter	Argentine Rosafe	Australian
Mar.	1.61	1.35	1.45	1.33	1.45	1.28	1.25	1.60	1.51	1.54	n.q.	1.44	1.56
	1.66	1.38	1.48	1.33	1.47	1.29	1.28	1.63	1.56	n.q.	n.q.	1.46	1.60
	1.68	1.36	1.45	1.31	1.48	1.30	1.30	1.64	1.56	1.58	n.q.	1.48	1.62
	1.70	1.41	1.47	1.35	1.49	1.32	1.31	n.q.	1.56	1.61	n.q.	1.51	1.61
	1.76	1.41	1.47	1.35	1.50	1.33	1.30	n.q.	1.56	1.62	n.q.	1.51	1.61
Apr.	1.81	1.43	1.51	1.35	1.51	1.35	1.31	n.q.	1.56	1.63	n.q.	1.51	1.61
	1.86	1.44	1.52	1.40	1.54	1.40	1.33	1.67	1.58	1.62	n.q.	1.52	1.62
	1.99	1.56	1.67	1.46	1.58	1.44	1.38	1.72	1.66	n.q.	n.q.	1.59	1.68
	2.12	1.65	1.71	1.41	1.60	1.45	1.39	1.71	1.64	n.q.	n.q.	1.56	1.66
May	2.20	1.69	1.74	1.48	1.63	1.47	1.42	1.75	1.67	n.q.	n.q.	1.62	1.70
	2.04	1.64	1.68	1.44	1.61	1.45	1.42	1.75	1.65	n.q.	n.q.	1.60	1.69
	1.81	1.51	1.60	1.36	1.55	1.40	1.38	1.68	1.61	n.q.	n.q.	1.57	1.67
	1.79	1.53	1.61	1.38	1.56	1.41	1.38	n.q.	n.q.	n.q.	n.q.	1.61	n.q.
June	1.83	1.55	1.61	1.36	1.50	1.36	1.37	n.q.	n.q.	n.q.	n.q.	1.58	n.q.
	1.87	1.51	1.56	1.36	1.48	1.33	1.35	n.q.	1.54	1.65	n.q.	1.55	1.65
	1.80	1.49	1.51	1.29	1.42	1.29	1.30	n.q.	1.50	1.63	n.q.	1.49	1.63
	1.75	1.49	1.51	1.26	1.39	1.28	1.27	n.q.	1.42	1.59	1.53	1.43	1.60
July	1.72	1.45	1.52	1.27	1.39	1.28	1.28	n.q.	1.46	1.55	n.q.	1.46	1.57
	1.72	1.36	1.53	1.32	1.40	1.29	1.32	n.q.	1.52	1.58	n.q.	1.54	1.59
	1.55	1.28	1.49	1.24	1.35	1.24	1.30	n.q.	1.44	1.57	1.47	1.51	1.59
	1.51	1.26	1.46	1.19	1.29	1.18	1.27	n.q.	1.41	1.53	1.46	1.45	1.56
	1.47	1.18	1.38	1.17	1.24	1.12	1.22	n.q.	1.28	1.44	n.q.	1.44	1.48

* United States prices are weekly averages of daily weighted prices for weeks ending Friday, compiled from *Crops and Markets*. Canadian prices are averages for weeks ending Saturday, compiled from *Canadian Grain Statistics*. Liverpool prices are for Tuesday of the same week and are from Broomhall's *Corn Trade News*. Argentine prices are averages for weeks ending Saturday, from *Times of Argentina*. No quotation is signified by "n.q."

TABLE X.—MONTHLY PRICES OF DOMESTIC WHEAT IN EUROPE, FROM AUGUST, 1925*

(U.S. dollars per bushel)

Month	Great Britain			France (Chartres)			Italy (Milan)			Germany (Berlin)		
	1925–26	1926–27	1927–28	1925–26	1926–27	1927–28	1925–26	1926–27	1927–28	1925–26	1926–27	1927–28
Aug.	1.53	1.76	1.63	1.62	1.61	1.75	1.88	1.85	1.75[a]	1.55	1.75	1.78[b]
Sept.	1.48	1.46	1.43	1.57	1.77	1.57	1.94	2.03	1.73	1.38	1.71	1.68
Oct.	1.34	1.48	1.37	1.48	1.88	1.54	1.94	2.21	1.77	1.37	1.72	1.62
Nov.	1.45	1.62	1.32	1.37	1.96	1.48	1.99	2.20	1.90	1.49	1.78	1.57
Dec.	1.60	1.55	1.29	1.33	1.78	1.58	2.12	2.31	1.88	1.62	1.74	1.53
Jan.	1.60	1.55	1.29	1.39	1.88	1.58	2.17	2.13	1.93	1.61	1.72	1.52
Feb.	1.54	1.54	1.26	1.42	1.81	1.56	2.16	2.11	1.94[c]	1.60	1.72	1.49
Mar.	1.51	1.52	1.27	1.39	1.70	1.65	2.14	2.11	....	1.66	1.73	1.59
Apr.	1.57	1.50	1.34	1.40	1.82	1.74	2.20	2.02	....	1.87	1.76	1.72
May	1.75	1.58	1.43	1.39	1.91	1.87	2.19	2.16	....	1.92[d]	1.92	1.73
June	1.77	1.65	1.43	1.52	1.88	1.85	2.20	1.99	....	n.q.	1.96[e]	1.66
July	1.84	1.64	1.41	1.53	1.81	1.76	1.98	1.80	....	n.q.	n.q.	....

* Data for Great Britain are averages of weekly average *Gazette* prices as given in the *Economist;* for France, averages of Saturday prices furnished directly by Federal Reserve Board; for Italy, averages of Friday prices of soft wheat as given in *International Crop Report and Agricultural Statistics;* for Germany, monthly average prices as given in *Wirtschaft und Statistik*. All data are converted, for convenience, from the domestic currency in which they are quoted in the above sources into U.S. money by monthly average exchange rates. No quotation is signified by "n.q."

[a] Three-week average.
[b] Second half of August.
[c] First half of February.
[d] First half of May.
[e] First half of June.

TABLE XI.—APPROXIMATE DISPOSITION OF WHEAT SUPPLIES IN FOUR LEADING EXPORTING COUNTRIES, 1923–24 TO 1927–28*

(Million bushels)

Item	United States (July–June)					Canada (August–July)				
	1923–24	1924–25	1925–26	1926–27	1927–28	1923–24	1924–25	1925–26	1926–27	1927–28
Initial stocks	151[a]	165[b]	135	111	138	29	41	26	35	48
New crop	797	864	676	831	873	474	262	395	407	440
Total supplies	948	1,029	811	942	1,011	503	303	421	442	488
Net exports	135	258	95	209	194	346	192	324	292	332
Seed requirements	79	84	82	89	96	39	39	40	39	41
Consumed for food	477	479	492	492	502	42	42	42	44	45
Unmerchantable and lost in cleaning	92	73	31	14	77	31	22	18	31	39
Fed on farms						15	5	5	10	10
Apparent error in crop estimate						−11	−23	−43	−22	−54
Stocks at end	165[b]	135	111	138	142	41	26	35	48	75
Total disappearance	948	1,029	811	942	1,011	503	303	421	442	488

Item	Argentina (August–July)					Australia (August–July)				
	1923–24	1924–25	1925–26	1926–27	1927–28	1923–24	1924–25	1925–26	1926–27	1927–28
Initial stocks	56	63	57	67	61	42	38	36	30	41
New crop	248	191	191	221	239	125	165	115	161	110
Total supplies	304	254	248	288	300	167	203	151	191	151
Net exports	172	123	94	143	178	86	124	77	103	69
Seed requirements	21	23	25	24	25	10	11	11	12	12
Consumed for food	45	49	54	55	56	28	29	29	30	30
Feed and waste	3	2	8	5	4	5	3	4	5	5
Stocks at end	63	57	67	61	37[c]	38	36	30	41	35
Total disappearance	304	254	248	288	300	167	203	151	191	151

* Based so far as possible upon official estimates for the various items of supply and disposition. Estimates for 1927–28 are preliminary. For detailed explanation of our method of estimation and adjustment of items in the disposition table, see notes in WHEAT STUDIES, IV, 61 f.

[a] This estimate perhaps too low. See WHEAT STUDIES, February 1928, IV, 169–70, 180.
[b] This estimate perhaps too high. See *loc. cit.*
[c] Presumably too low. See text, p. 368.

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